MAY 2 1 1932

Engineering News-Record

Construction or Dole

••• The public-works doctrine is spreading, for there is but one issue today—Construction or Dole. Newspapers are beginning to discuss it. Washington has begun to see it. And throughout the country concern over what can be done to rebuild employment and business is crystallizing into a demand for governmental action that finds its only expression in public construction.

••• What public construction can accomplish in today's emergency is set forth by the American Society of Civil Engineers: It will start a train of employment and stimulate private industry; will add to buying power without producing a further excess of consumer goods; and will conserve the funds expended by creating needed community facilities.

••• Three billion dollars of necessary work is ready to go forward when the nation makes up its mind to break the financial deadlock and resume work. As Walter Lippman says, "There comes a time in every depression when the way to resume is to resume." That time is at hand, for demands for a national dole are crowding in on the federal government. Declining employment, power and manufacture make them more insistent each day.

••• Shall it be construction or dole?

From an editorial in this issue

May 19, 1932

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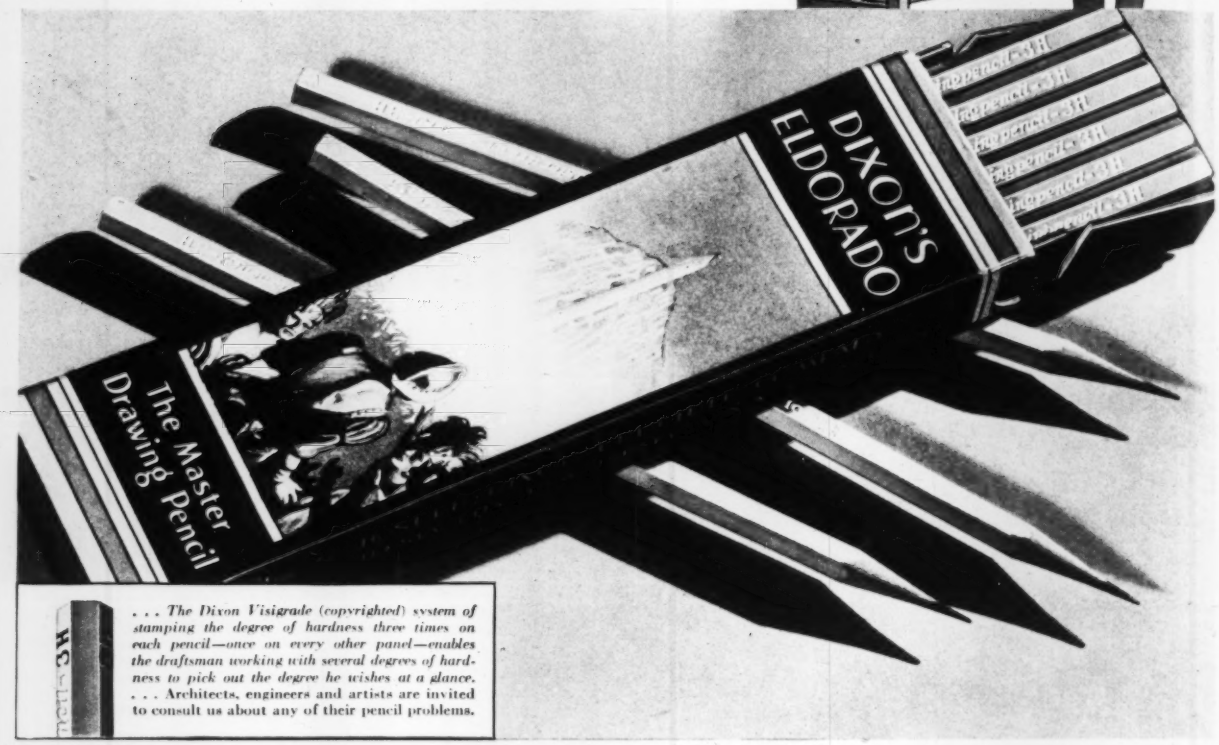

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F. E. Schmitt, Editor

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Construction or Dole

A GREAT forward movement is going on in the country's thinking. The week's developments reveal that the public-works doctrine is spreading; people are talking about it, the newspapers discuss it, and Congress has suddenly become construction-conscious. The President, forsaking his long-maintained opposition, has expressed approval. Back of these significant developments is the pressure of continued industrial stagnation, which is patently leading on to a crisis. It is this pressure that makes construction or dole the paramount issue.

Today no one questions that work is the only cure of our present difficulties. When welfare experts and labor leaders weeks ago warned of the critical situation, their pleas were little heeded. The work which they demanded for the unemployed was looked upon as a relief expedient—disguised charity—something little related to the recovery of business. Events since then, however, have taught a severe lesson, and it is now clear to all that the security and welfare of every individual and institution is at stake in the unemployment problem.

THE current spring season has belied every past experience. April and May, months of activity and enterprise, this year brought neither jobs nor new confidence. With this fact before his eyes, even the man in the street understands how deeply unemployment reacts on all human and business relations. He knows that the economic paralysis will not be cured until earning power is restored through employment.

Will private industry provide the employment? There are able observers who profess to see signs that decline and deflation have reached their end; yet at no time during the course of the decline has the impotence of private business been so apparent as now. The year's busiest season brings no evidence of animation; winter levels are carrying over into the summer. In a desperate effort to rebuild business, the financial structure of banks and railroads was propped up and solidly founded on the nation's public credit, but even this extreme measure did not help the citizen, business man or wage-earner. Contentions that business would accelerate after the banking panic was quieted proved fallacious .

THIS is the answer given by the facts of recent months. The jobless worker and the business man who faces bankruptcy cannot wait longer for private industry to restore earning power. Public construction is their sole hope of salvation.

Many continue to oppose a large public construction program as unsound. There are those who say that more public works are not needed at present. Others claim that they could not be financed except at the risk of throttling the credit needed by private business and undermining the value of government bonds. Still others object that only a few kinds of workers would be used in construction, leaving the grocer's clerk, the machinist and the bookkeeper in idleness.

Answer is made to these objectors by the clear and illuminating statement which we print in this issue, the brief of the American Society of Civil Engineers in support of its resolution indorsing a public construction program. The brief sets forth in concise terms what public construction will accomplish. It explains how, if construction is set in motion quickly and on a large scale by drawing on the reservoir of delayed requirements of cities and states, it will start a train of employment that will in turn set in motion every line of private industry. Construction will add to buying power without producing more of the consumer goods that already glut the market. It will conserve wealth instead of wasting it in doles.

IS THERE enough work to employ the idle, and can it be set in motion quickly? Again the Civil Engineers' brief gives reply. It shows that there is no need to devise vast new projects—a countrywide superhighway network or canal system. Where railway electrification, grade-crossing work and mass housing can show advantage they might be worthy of consideration, but even without these the recent curtailment of normal improvements by states and cities makes two billion dollars of work available. In other words, resumption of normal programs can put some millions of men to work, either on the job itself or in mill, factory, railroad yard and store. The work is ready to go ahead if the nation makes up its mind to break the financial deadlock and resume.

WE HAVE temporized with depression and unemployment for many months, to disastrous effect. We have talked of stabilization without making sure that there will be something to stabilize. Walter Lippmann pertinently said a few days ago in one of his cogent discussions of events, "There comes a time in every depression when the way to resume is to resume." That time is at hand, and public construction affords the way. We must resume or else face a national dole.

Congress has the question before it. It knows that employment, power and manufacture are still declining and that action is necessary before adjournment. Differences on details—direct or indirect credit, restriction to revenue-producing projects, inclusion of private business—can be adjusted in time, unless political conflict proves too strong. On that contingency hangs the issue of construction or dole.

NOTES OF THE WEEK

Skill at a Premium

TIMES of stress have the inestimable value of calling out the pioneer qualities of men and restoring them to an honor often denied in boom times. Ability, perseverance, integrity count heavily when competition is keen and when every performance must be efficient and sure. In such times scientific skill in engineering has opportunity to win new recognition, not obtainable in the days of driving speed and good-enough approximation. The economies that scientific precision in analysis and design can produce are never negligible, but they have particular importance under conditions in which every dollar counts. For this reason they come to the front in times like the present and receive renewed attention in all designing and construction. Their higher valuation represents a welcome gain to the technical arts, for every application of scientific refinement will have a continuing influence in raising the level of engineering practice.

Protect the Patient

NOT long ago we had occasion to speak of the opportunities for rehabilitation and improvement work in bringing institutional buildings up to a higher level of safety and decent comfort. On the whole such buildings have many shortcomings, we said. Some confirmation of that estimate is furnished by a recent paper on hospital conditions by H. F. J. Porter, who has had long experience in fire protection for institutions and factories. He states that from visits to many hospitals commonly regarded as safe he knows that "they are far from safe from the standpoint of fire hazard." This is a situation hard to condone or tolerate. Hospital patients as well as other inmates of institutions are usually incapable of helping themselves in an emergency, and thus have a special claim to every precaution that will assure their safety. Trustees and managers have no higher obligation than that to protect against fire and panic.

New Battles Ahead

OPPOSITION and apathy combine to make poor prospects for amendment of the federal prevailing-rate-of-wage law. The law has worked after a fashion, in spite of its failure to require advance declaration of the prevailing rate, largely because during the last year nominal wage rates held with little change. But new and widespread wage-reduction tendencies create prospects for trouble. Bidders on public buildings have an incentive to figure on coming reductions in wage rates, since under the existing law they are allowed to profit from any gain through such reductions. It is true that the Secretary of Labor is the deciding judge on rates, but his decisions after all are subject to the test of fact; courts have never upheld arbitrary official findings. Were the pending amendments adopted they would require advance declaration of rates and adjustment of contract payment when rates are changed, thus removing the temptation to depress wages and eliminating many causes of battle. Under the law without amendment many battles lie ahead.

Leading Articles

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Finishing a Long Job

THE overwhelming majority accorded the $6,500,000 bond issue required to complete the Hetch Hetchy water-supply system for San Francisco indicates public recognition of the value of protecting a valuable investment, as well as a steadfast spirit to complete this great project. With expenditures approaching $100,000,000 to date, and money now needed only to complete the last five-mile section of the Coast Range tunnels, the situation presented no logical alternative. Aside from the importance of finishing the project the provision of funds to continue the work has an equally important purpose at present, for without these funds the work on the tunnels would have been curtailed and possibly shut down, putting some 1,300 men out of work. This contingency alone was reason enough for a city such as San Francisco to provide this fund at the present time. The water-supply project on which San Francisco has been actively working for almost two decades can now be completed according to program, and in addition hundreds of jobs will be maintained at a critical period of unemployment. In both respects the action of the voters is cheering news.

Home Mortgage Prospects

LATE reports from Washington indicate that the mortgage-discount bank proposal has not been shelved, but is soon to be given active consideration. This is good news, for current conditions afford a convincing demonstration of the affect of building and land credit on the state of general business. So much credit has disappeared by reason of the devaluation and immobility of realty assets as to make evident that we cannot hope to have a stable economic system while the violent fluctuations of realty credit remain uncontrolled. Once a credit market for home mortgages is established the effect of business oscillations on general confidence is certain to be decreased greatly. Inclusion of city housing operations in a discount system may be desirable, but is probably not necessary. It has in its favor the forceful argument that such operations offer a prime field for useful employment in depressed periods, when banking credit channels are clogged. But even though nothing more than the individual home mortgage were included in the system at first, our economic stability would be improved.

Save or Spend?

SOME of the vexing questions involved in reduction of public expenditures are illustrated in recent statements of the New England Council. In its *News Letter* for May it urges on the first page "the maximum reduction possible in public expenditures." A few pages later, however, it speaks approvingly of the trend toward state participation in unemployment relief to reduce the burden borne by local communities and private charity. Since there will be increased public

expenditure if the state treasury takes over the charity burden borne by private agencies, the Council is in the position of advocating in the same breath increase and reduction of public expenditure. This inconsistency, which is not unnatural, reflects the essential problem of public economy—namely, to determine what services shall be reduced. As we have previously pointed out, the services rendered by local governments—whether relief work, hospital service, street paving or sewerage—are furnished in direct response to the needs and demands of the citizens, and citizens may disagree on which can best be abolished or curtailed. Blanket demands for tax reduction and curtailment of expenditures are therefore of no help in dealing with the problem; but constructive analysis and counsel can contribute to its solution.

Flood Safety at a Bargain

HOWEVER forcefully the argument for preventive flood-protection measures has been made in the statement of C. A. Bock, it warrants further emphasis. The history of stream valleys and their flood troubles is full of stories of neglectful disregard of community safety on the part of both private interests and cities themselves. Not often do the public authorities build encroachments that may dam up floodwaters and inundate their town, but very often indeed do they fail to notice or check encroachment by other riparian occupiers. Mr. Bock's main point—and it is one of great importance—is that public authorities owe their citizens the duty of diligence in this regard. The local officials, however, are usually hampered by lack of adequate knowledge. Since full understanding of stream characteristics and hazards can in general be acquired only by a central authority, a state supervisory board over waters and channels is proposed. The suggestion merits wholehearted indorsement, for its value to the citizen in dollars as well as in protection against potential suffering is apparent to everyone who has shared or witnessed floodtime experiences.

Chance for a New Approach

A MOVEMENT looking toward the registration of engineers and architects has been started in Connecticut. Neither engineers nor architects are registered in any of the New England States, though a few attempts have been made to pass laws providing for the registration of one or the other of the two professions. The failure of these efforts appears to be due in part to the conservatism of the region and in part to the lack of strong evidence of the need for such legislation. While direct proof of need still is wanting, the engineers of the region are finding that their lack of licenses is a handicap when they attempt to practice in states having registration laws because they cannot come in under a reciprocity clause as is now general among states having such laws. Looking back upon what has happened in recent years in states having separate license laws for architects and engineers, it is to be hoped that the two professions in New England will seek registration under one law. The basis for registration is the same and the distinctions between architects and engineers are not of sufficient importance to offset the advantage to be gained through simplification of administration and elimination of possible sources of interprofessional conflict. Absence of license laws in New England gives opportunity for a new approach to the subject.

Transport Regulation Advances

UNIFORMITY in the regulation of all forms of transportation, rail, motor and water, has become steadily more necessary for several years; it has become imperative with the general falling off in the movement of commodities during the past two years and the consequent intensifying of competition among transportation agencies. Only rail transportation agencies are now effectively regulated. Bus and truck operators are regulated to a limited degree by state governments, and barge lines go practically unregulated.

When the amount of traffic handled by agencies other than rail was small, no critical conditions arose, but with the great increase in the amount of traffic handled by buses and trucks in the past decade a situation has developed which needs to be corrected if our transportation system is to be kept sound. The country cannot indefinitely exercise control over the rates, hours of work, working conditions, accounting methods and financial set-up of one form of transport while permitting competing agencies to go free from like regulation.

Congress has given considerable attention to the subject during the past two or three years but has made little progress because most of the testimony thrust upon its committees has been of a partisan nature—railroads fighting to have their competitors regulated and to put a stop to what they call government subsidies to their competitors, and the bus and truck organizations opposing almost all forms of regulation. Now, for the first time, Congress has before it specific non-partisan counsel as to what regulation of buses and trucks is immediately desirable. This is in the form of recommendations by the Interstate Commerce Commission as to what legislation is needed.

In general the commission's recommendations, which are conservative, should be acceptable to all except the extremists on either side. They were outlined in detail in our issue of May 5, p. 660. For the present they call for placing the minimum amount of regulation upon interstate operation of passenger buses and of both common-carrier and contract-carrier trucks. The immediate aim of this regulation is to get all such interstate operators on record and to begin to build up such operating statistics as are necessary to a determination of their competition with the railroads and one another.

What is needed is an accurate determination of field of activity in which each form of transport can be of most value to the country. We need to know the extent to which competitive services should be maintained or duplication restricted, the desirable amount of coordination to avoid wasteful duplication, what part of our present restrictions upon rail rates should be eliminated, and how the rates and labor conditions of motor transport should be adjusted. How this is to be accomplished no one knows, but it cannot be accomplished without knowledge of many factors that are now unknown. These the commission seeks to determine.

In that move the railroads can help, not only through abandonment of their present attacks upon highway construction itself but by reasonable efforts to educate the public as to the need for such a determination of facts and by careful analysis of their own motor truck and bus operations. Transport regulation is approaching a state of flux; what comes from the crucible at the end of that period will depend in no small part upon the manner in which the subject is handled in this transition period.

Bottom Heading Driving on C.P.R. Tunnel in Quebec

Unusual tunneling methods, including scraper mucking, permit mile-long single-track bore to be completed in eleven months—Upper section broken down onto timber platform—Concrete lining carried on with driving

By Thomas F. Russell

Engineer, Sullivan Machinery Co., Montreal, Que.

THE BOTTOM-DRIFT method of tunnel driving, common in Europe and in Japan, has rarely been used on the American continent. One instance is the Dead Horse Gulch tunnel on the Great Northern Railway in Washington, completed in 1928. The extension of the bottom-drift method to full-width bottom-heading driving was a notable feature of the Wolfe's Cove tunnel, described in the following article. Another feature at Wolfe's Cove was the use of scrapers for mucking. Scraper mucking, while finding wide use in the mining field during recent years, is unusual in tunnel construction. Prominent examples of this method of mucking are the combination of scraper and shovel mucking used in the Cascade tunnel, full scraper mucking in the Chicago water tunnels now under construction, and the use of scrapers in cleaning up the invert of the New York City 20-mile aqueduct tunnel No. 2. The unusual tunneling methods at Wolfe's Cove were selected to meet a fast driving schedule. Their success is indicated by the completion of the tunnel within the required time limit. —EDITOR.

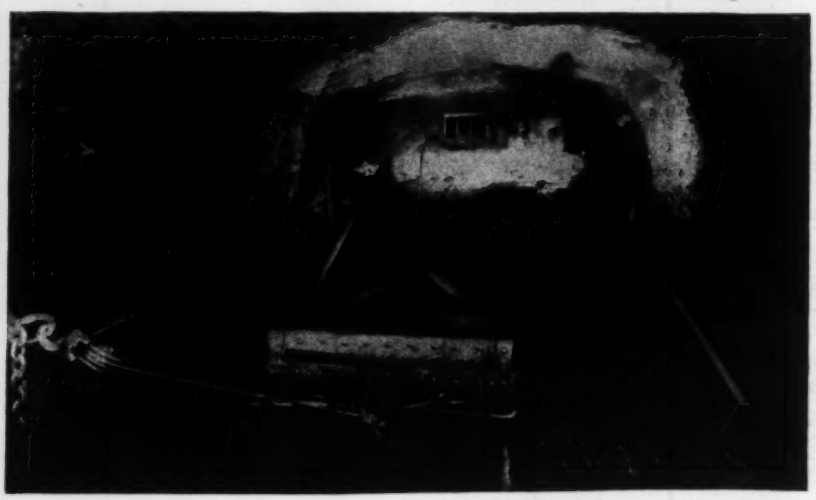
IN THE CONSTRUCTION of the mile-long Wolfe's Cove tunnel by the Canadian Pacific Railway at Quebec a combination of full-width bottom-heading driving, scraper mucking and placing concrete lining along with the excavation work permitted the completion of the job in eleven months. This fast schedule was necessary to open up a new deep-water terminal at Quebec before the Canadian Pacific's newest and largest steamship, "Empress of Britain," went into service last year. The upper section of the tunnel was removed by breaking down onto timber platforms, from which the muck was drawn by gravity. Concrete lining was speeded up by drilling three 8-in. holes from the surface into the tunnel, through which dry aggregates were dropped close to the mixers and pneumatic placing machines.

The new water terminal is located at Wolfe's Cove at the foot of the rocky heights bordering on the historic Plains of Abraham. A new railroad line 1½ miles long was necessary to connect the terminal with the C.P.R. main line at St. Malo at the western edge of the city. More than a mile of this new line is in the tunnel passing through the rocky promontory upon which Quebec is situated. Boat trains now can reach the steamship pier directly from the main line, eliminating the former slow trip through the city and railroad yards to the old wharf.

Tunnel design

The rock formation traversed by the tunnel is termed Quebec City limestone, but in reality it is a shale formation of varying hardness. It is fairly hard for 2,000 ft. in from the Wolfe's Cove portal, but toward the St. Malo end the formation became soften and rapidly disintegrated upon exposure. No prevailing dip or strike can be attributed to this shale, as it curls in all directions and contains numerous intrusions.

Fig. 1—Scraper mucking in C.P.R. tunnel at Quebec. The scraper bucket is just starting up the slide. Double-drum electric hoist can be seen in background.



The tunnel is a single-track bore 5,330 ft. long with an 0.8 per cent grade dropping toward the Wolfe's Cove end. The clear width inside is 16 ft., and the height from the base of the rails to the intrados of the arch is 22½ ft. The walls are vertical, and the roof is formed of a semicircular arch having a radius of 8 ft. Concrete lining was placed throughout, the thickness being governed by the nature of the ground penetrated. In self-supporting rock the thickness of the walls is 9 in. and of the arch 1 ft. In timbered sections through soft rock a reinforced-concrete lining with a thickness of 2 ft. 3 in. was placed. Near the Wolfe's Cove portal, where the rock is self-supporting but is subject to frost action, reinforced-concrete lining 1 ft. 3 in. thick was placed. Maximum overburden on the tunnel is 350 ft.

Driving bottom heading

The tunnel was driven by the bottom-heading and trapping method. A bottom-heading full width was carried to a height of 11 ft., with a 4-ft. bench 12 ft. long. Drilling was done with three 3½-in. drifters set on two vertical columns equipped with extension arms. The cut holes were drilled 13 ft. deep and rib holes 11 ft. The bench was broken by two rows of lifters 12 ft. deep drilled from a crossbar, usually ten holes being required. About 80 yd. of rock per shot was broken up in the bottom heading. Drilling time was 3 to 3½ hours.

Scraper mucking

The bottom headings were mucked out by the use of a scraper and slide powered by a 50-hp. double-drum electric hoist. The slides were designed to accommodate two cars underneath. Rails on a 7-ft. gage carried the slide. The scraper used was 60 in. wide, with a back 30 in. high curved to an 18-in. radius.

At the start of the mucking operation eyebolts were wedged in holes drilled in the side walls against the face. Between these eyebolts a chain was suspended carrying a 10-in. roller tail sheave for operation of the scraper. The rock broke very fine as a rule, but occasionally large boulders were encountered. As the muck did not fly but fell dead at the face, the first operation of the scraper was to pull the muck out of the way to allow the drillers to set up and resume drilling. After the muck has been cleaned away from the face the cross-chain from which the tail sheave was suspended was moved back clear of the drillers. The muck was then scraped up the slide and into the cars.

The mucking crew consisted of four men at the face, shoveling a small amount of muck left along the side walls, and one hoist operator. The slide itself was moved up but once a week—on Sunday, when operations were suspended. While the speed of mucking was greatest when the slide was close to the face, the average time

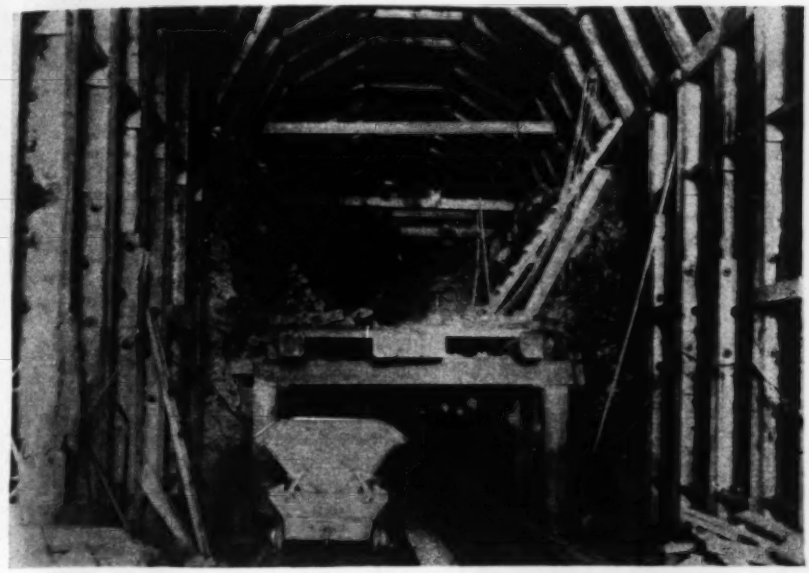


Fig. 2—The upper section of the tunnel was broken down onto timber platforms, and the muck was trapped into cars. Muck was left on timbers long enough to serve as a working platform for the drillers, thus eliminating scaffolding.

over the entire week was twenty 2-yd. dump cars per hour.

Switching the cars

A simple but efficient method of switching the cars behind the slide was designed on the job. It consisted of a cross-over switch laid over the track, light enough for one man to remove or replace when necessary.

At first it was contemplated running two cars under the slide. Later it was found more efficient to close up the first opening in the deck of the slide and to use only one car under the second opening. While a loaded car was being switched out, the hoist operator piled up the muck over the blocked-off first opening. The first trip of the scraper after the empty car was in place carried all the accumulated muck on the slide into the car. This filled the car nearly full, and one or two additional trips of the scraper completed the job.

Upper section broken down

The material in the tunnel above the bottom heading was removed by shooting it down on the breakdown timbers and drawing the muck into cars by gravity without further handling. Breakdown timbers were set up in the bottom heading at a height of 7 ft. above the invert at several convenient points. A raise slanting toward the face was then started in the roof of the heading. The muck was allowed to pile up on the breakdown timbers to form a working platform and a support for the columns from which the top heading was drilled. Where the rock was self-supporting the breakdown was shot in two slices. The first slice was taken at full width to a height of 9 ft. and was carried 20 ft. in advance of the arch face. Through soft rock the breakdown was taken out in full section, with crown bars used in the roof where necessary.

Two drifters were used in drilling the breakdown in each heading, about three hours being required for drilling the full section. The burden on the holes was between 2½ and 3 ft., and the holes were drilled to a depth of 13 ft. When the breakdown face had advanced far enough so that drawing off the muck would not disturb the pile on which the drillers were working, several roof planks of the breakdown timbers were knocked out, and the muck was drawn by gravity into cars below. The setting for this operation is shown in Fig. 2.

In the Wolfe's Cove end of the tunnel the rock was self-supporting, and no timber was required except for a few sets at the portal. At the St. Malo end the rock was bad from the start and was heavily timbered all the way. Timbering consisted of 12x12-in. wall plates carried by 12x12-in. plumb posts and a 12x12-in. five-segment arch set 4 ft. c. to c. Behind the arch segments and side walls, where necessary, 3x6-in. lagging was placed. Timber was used for dry packing between the lagging and the rock. Although many rock falls occurred in the St. Malo end, no serious accidents occurred.

Concrete lining

Concrete lining was placed from both portals and from three intermediate positions under the well drill holes topping the surface. Conveying dry material for concrete through these holes helped considerably in reducing interference between the muck-handling and concrete operations.

The first operation in placing the concrete lining was to pour bench walls 4 ft. high, using wood forms. Concrete was conveyed to location in muck cars

Fig. 3—A full-width bottom heading was drilled from two columns. Long extension arms permitted the drills to cover the entire face from one column set-up.

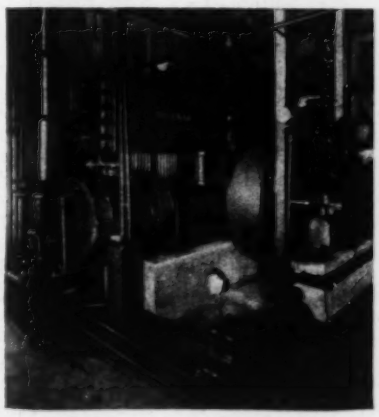


Fig. 4—One of five angle-compound compressors on the tunnel, each being of 1,035-cu.ft. per minute capacity.

and was shoveled behind these forms by hand. The concrete above the bench walls was shot behind collapsible steel forms through a 6-in. pipe by pneumatic placing machines. The steel-form sections were 40 ft. long.

Plant

Five electrically driven angle-compound air compressors, each with a capacity of 1,035 cu.ft. per minute, were used, two being placed at the Wolfe's Cove end and three at the St. Malo end. Drill sharpeners and furnaces were installed at each portal. At each portal a compressed-air blower, electrically driven, provided ventilation in the tunnel. At the St. Malo end the muck and the concrete cars were handled by a trolley locomotive. At the Wolfe's Cove end empty cars were hauled from the tunnel to the face by horses and were returned loaded by gravity. Steam locomotives handled the cars from the portal to the dump. A sawmill at the St. Malo end sawed all the timbers used for lining and for breakdown platforms.

Contractor and personnel

The work was carried out under the direction of D. Hillman, engineer of construction, Canadian Pacific Railway, with H. M. Dibblee in direct charge. The Dominion Construction Co. held the contract. P. J. Lewelling was in charge of the work for the contractor, assisted by Jack Harrington. The Sullivan Machinery Co. assisted in the design of the scraper mucking equipment.

Graphic Method Aids Plotting of Hydrographic Locations

Development of plotting charts permits rapid and accurate locating on field sheets in 10 sec. after reading two sextant angles

By Henry S. Pond

Senior Engineer, U. S. Engineer Department, San Francisco, Calif.

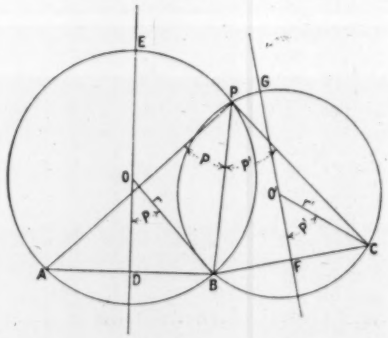
A GRAPHIC method for the rapid and accurate plotting of hydrographic positions located by two sextant angles has been used for some years in the San Francisco office of the United States Engineer Department. The positions are plotted in the field on sheets covering the working area, on which have previously been plotted pertinent data, such as channel lines and outlines of shoal areas together with the two systems of curves and the loci of the vertices of the two adjacent angles to three signal stations ashore. With the aid of the chart the location of the survey boat can be plotted within 10 sec. after reading the two sextant angles. The method of making and using the plotting charts is outlined in this article for other engineers engaged in hydrographic work.

Plotting charts were first developed for use in surveying channels and shoals in the vicinity of San Francisco that were checked periodically. As the technique of their preparation improved, their use was extended to practically all hydrographic surveying in the district, and they have been adopted by other local engineers on allied work. They are valuable aids in dragging operations and salvage work. In addition, they have been used by public utility companies in laying and locating submarine cables. Plotting charts are the most satisfactory means known to the writer for locating a position on the water quickly and accurately. Further, they are convenient for subsequent drafting-room procedure, as the finished survey maps are made by plotting from the notes directly onto a tracing placed over the tracing or hard-paper copy of the plotting chart.

Preparation of the Charts—If the known positions of the shore stations are geographic, they are first reduced to a system of plane coordinates by the method outlined in special publication No. 71 of the U. S. Coast and Geodetic Survey, "Relation Between Plane Rectangular Coordinates and Geographic Positions." The origin of coordinates is so chosen that all points will be in one quadrant.

If the shore stations and the area to be surveyed can be plotted at the desired scale within the limits of the drafting board, the plotting curves are usually made with a beam compass. Referring to Fig. 1, let A, B and C be three selected shore stations; p the distance AB; p' the distance BC; DE and FG the perpendicular bisections of AB and BC, respectively; P any point in the area to be surveyed, subtending angles P with AB, and P' with BC; O and O' the centers, and r and r' the radii of the circles APB and BPC respectively.

Fig. 1—Basic relations used in developing plotting charts.



$$\text{Then } DO = \tfrac{1}{2}\, p \cot P$$
$$FO' = \tfrac{1}{2}\, p \cot P'$$

The shore stations and the area to be surveyed are plotted to the desired scale, the chords AB and BC are drawn, and the perpendicular bisections DE and FG are erected with a beam compass. The probable maximum and minimum values of angles P and P' are determined from the drawing. The various values of DO and FO' corresponding to the full range of angles P and P' are calculated and laid off on DE and FG, respectively. It should be noted that if P or P' is greater than 90 deg., the center of the corresponding curve is on the opposite side of D or F respective to the area to be surveyed. The curves are then drawn in the section covering the area to be surveyed, using the centers laid out on DE and FG and taking the corresponding radii directly from the plat. A typical plotting chart is shown in Fig. 2.

It often happens that the area to be surveyed and the shore stations cannot be plotted at the desired scale on the drawing board, but that the area and the centers of all plotting curves within it can be so plotted. In this case the coordinates of the positions of O and O' and the corresponding length of r and r' must be determined. The lengths DO and FO' are not needed. If Θ is the bearing of DE, then:

$$\text{Latitude of } DO = DO \cos \Theta$$
$$= \tfrac{1}{2}\, p \cos \Theta \cot P$$
$$\text{Departure of } DO = DO \sin \Theta$$
$$= \tfrac{1}{2}\, p \sin \Theta \cot P$$
$$\text{and} \qquad r = \frac{\tfrac{1}{2}\, p}{\sin P}$$
$$= \tfrac{1}{2}\, p \operatorname{cosec} P$$

The formulas have been put into these forms to simplify computations in a calculating machine. All computations are multiplications, and the only variable in each formula is the function of angle P or P'.

The various centers of both series of curves are plotted on the sheet, and the curves are drawn with a beam compass. It is usually convenient to lay off the successive lengths of the two sets of radii at one time on two straight lines from the general positions of the two sets of centers to the area to be surveyed, for convenience in setting the beam compass.

If neither the shore stations nor the

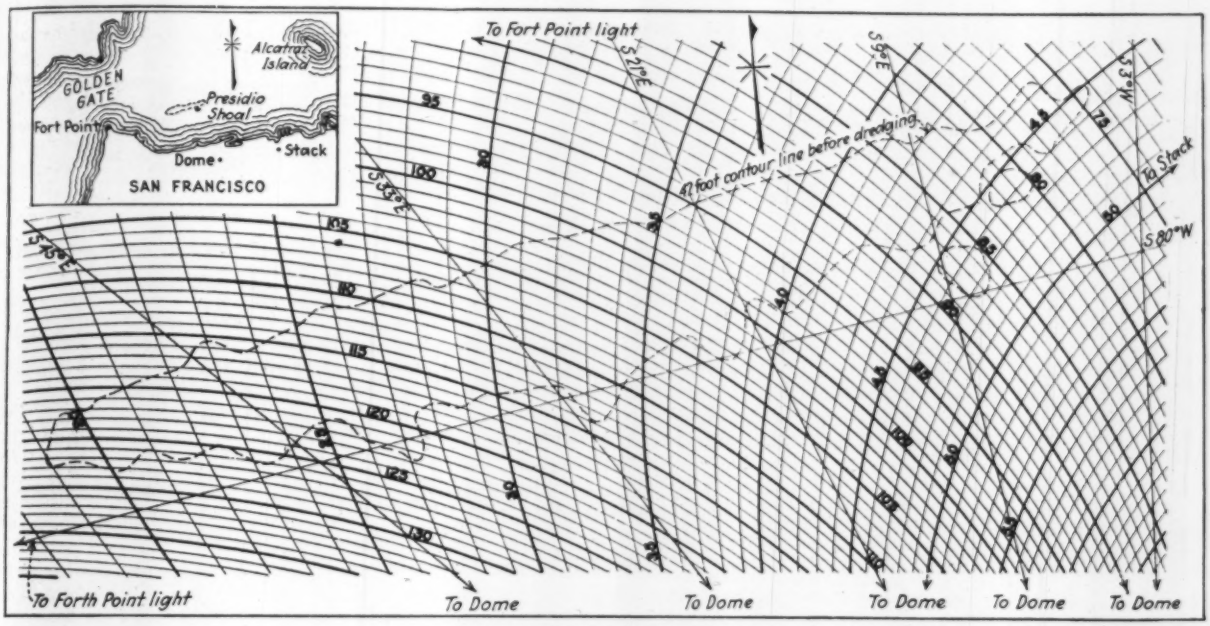


Fig. 2—Typical plotting chart for section of San Francisco Bay. Layout drawing from which the plotting chart (for field use) was made was large enough to include locations of shore stations and centers of curves.

centers of the curves can be plotted at the desired scale on the board with the area to be surveyed, the curves are laid out by offsets from tangents. The shore stations and area to be surveyed are plotted to a convenient scale on a separate sheet, from which the maximum and minimum values of P and P' are measured. The desired interval in degrees or minutes between curves is decided upon. The coordinates of the various centers of the two sets of curves and the corresponding radii are then calculated by the foregoing formulas. The coordinates of the middle point of the area to be surveyed are scaled from the small-scale map, and the bearings are calculated from that point to the middle one of each of the two sets of centers. Using these bearings reversed and the various values of r and r' and the coordinates of the corresponding centers, the coordinates of a point on each curve are determined.

These points are then plotted and tangents are drawn through them at right angles to the bearings used in calculating their positions. The curves are plotted by offsets from these tangents. It often happens that some of the calculated points fall too far to one edge of the sheet or off the sheet entirely. In this case new bearings are selected and new positions of points on the curves are calculated, with corresponding changes in the bearings of the tangents through those points.

Scale—Plotting charts can be made to practically any desired scale. The charts used for surveying the channel across the bar outside the entrance to San Francisco Bay represent an area that would have required a three-arm protractor with arms 10 ft. long. Others, used in connection with rock excavation in the bay, have been made on a scale of 1 in. equals 20 ft., where the distance from the center of the area to the shore stations varied from 4,000 to 10,000 ft. In this extreme case great care has to be taken that the sextants are in good adjustment to obtain satisfactory results.

Field Operations—The most frequent use for plotting charts is in connection with hydrographic surveying. Locations are determined by two sextant angles taken simultaneously by two observers at regular sounding intervals, usually about every fourth sounding. In actual procedure the leadsman calls the sounding, which is repeated back by the recorder. The sextantman taking the right-hand angle then calls his sextant reading, in the meantime having laid down his sextant and spotted the curve corresponding to his angle on the chart. This reading is also repeated back. The other sextantman then calls his angle reading, and the first locates and plots the point on the chart. The location is plotted on the field sheet not later than 10 sec. after the angles are taken.

In areas where there are no good shore ranges to guide the survey boat, which is frequently the case, soundings are taken along predetermined lines merely by first drawing the lines on the plotting chart. Any departure of the survey boat from the line is promptly detected and corrected. After a little practice with this method of running lines, shore ranges lose their importance.

The use of plotting charts in place of the three-arm-protractor method makes possible a smaller survey party and the elimination of the plotting board that is always in the way of everybody on the boat. With a plotting chart, satisfactory surveys along predetermined lines have been made with one leadsman, one boatman, one combination observer and recorder, one combination chief of party, observer and plotter and one man ashore reading tide gage.

Advantages—There are several distinct advantage gained by the use of plotting charts over the locating of positions with a three-arm protractor. With a protractor the time taken to set the movable arms, jockey the protractor into position, spot the point and remove the protractor is rarely less than 1 min. Further, when using a three-arm protractor, particularly when working near the limit of its length, the spring of the arms often introduces an error in the plotting. A second source of error is the practice of marking the shore stations on the board by pins, with the result that the protractor arm is not exactly over the plotted position of the shore signal. Plotting charts are not subject to such errors. If carefully made, they are limited in accuracy only by the limit of accuracy of the observed angles and of the locations of the shore stations.

A three-arm protractor is strictly limited in length of reach, and the choice must be made often between plotting at a smaller than desired scale and then enlarging, or of extending their length with straight-edges, both at a loss of time and accuracy.

Plotting charts, their use and the technique of their preparation have been developed by the writer and Reno E. Demeritt, associate engineer, from a method of plotting soundings used by James H. Bacon, U. S. assistant engineer, and described in *Engineering News* of March 26, 1903.

Crane Serves as Elevator in Five-Story Building

Industrial building of unique type is built at Bridgeport for wire-reel storage—Heavy loading, wood floors and arc-welded frame are characteristic elements of the design

By Andrew Vogel
General Electric Co., Schenectady, N. Y.

THE NECESSITY for speed in handling reels of wire in and out of storage resulted in a somewhat unique design for building No. 46, a 5-story structure 73 ft. wide by 193 ft. long in the Bridgeport plant of the General Electric Co. No elevators or stairways are used. The central bay is open from the first floor to the roof, and a crane located near the roof handles loads from floor to floor. In this central bay each floor from bottom to top is set back an amount equal to slightly more than the diameter of the wire reels to be handled. Ladders are used for access to the various floors. In addition to the unique basic plan, the frame of the building is of arc-welded construction, and the major part of the steel was delivered from the mill to the site without any fabrication or paint. Neither fabrication nor erection involved any unusual problems, fabrication consisting largely of welding clips to beams and girders, and erection being carried out by a locomotive crane.

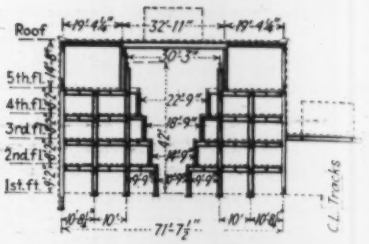
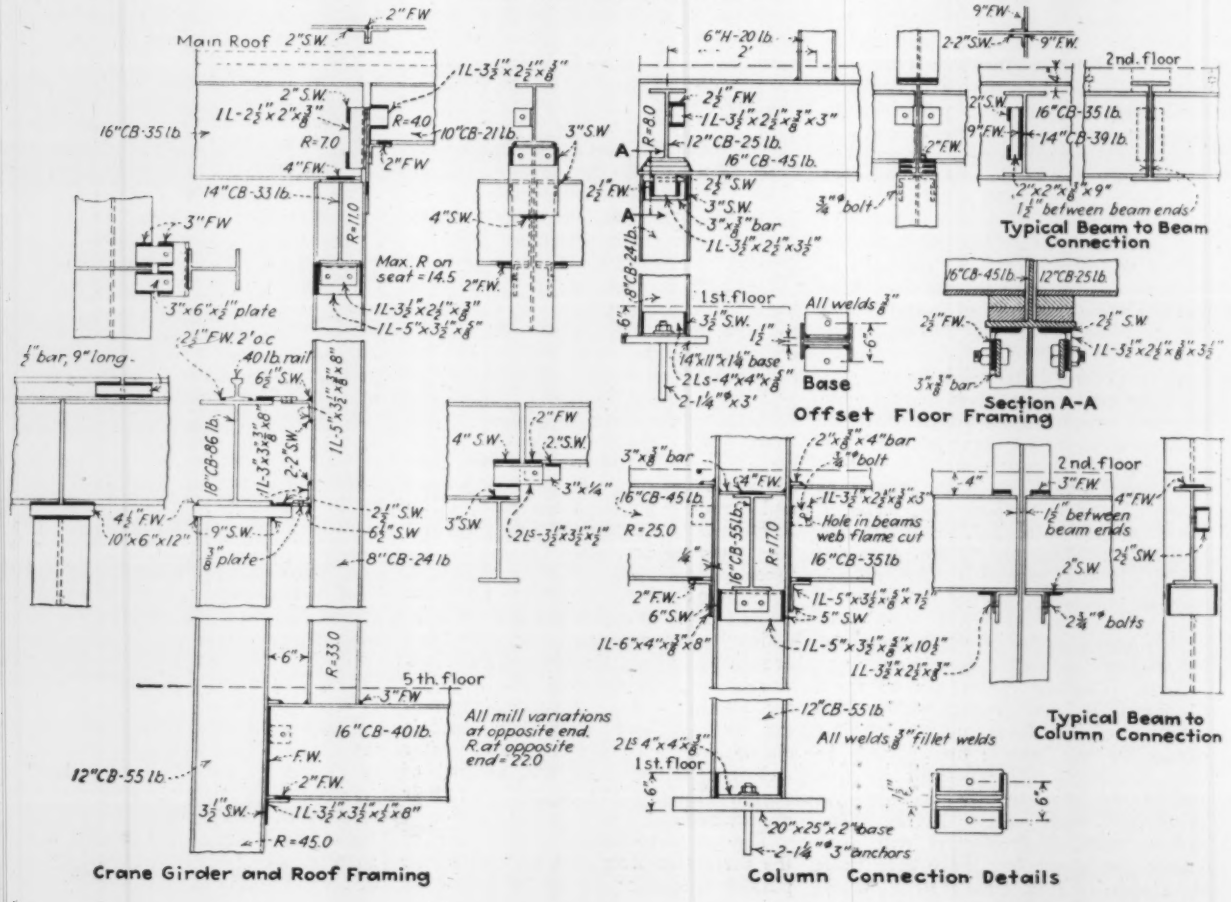


Fig. 2—Cross-section of Bridgeport building, showing how overhead crane provides elevator facilities.

Simple floor construction

The method of storing the wire and cable reels determined the height of the stories above the first as well as the upper floor loads, which were fixed at 400 lb. per sq.ft. The first floor is of a reinforced-concrete slab resting directly on the earth. The second to fifth floors inclusive were provided with 4-in. plank boards secured to the floor beams by clips. No finished floor was placed on these planks, as the occupancy did not require a smooth surface. However, the planks were placed at right angles to the main axis of the building, so that the edges of the reels could roll lengthwise of the planks. At the wall and aisle edges of the plank floors, 4x6-in. strips of timber were bolted to the floors to act as stops for the reels. Pipe standards and chain guards also were arranged to prevent employees from walking into the open space. For the roof 2-in. planks spiked to nailing strips were clipped to the beams. In order to obtain satisfactory daylighting in the building, two

Fig. 1—Welding details of building for cable-reel storage, Bridgeport, Conn.



large sawtooth skylights of vertical-face type, facing north, were located over the central aisle. There are also vertical-face sawtooth skylights in the small lean-to building that covers the railroad siding and shipping platform (Fig. 2). Exterior walls are of brick with steel sash and clear glass.

Interior column design

In order to handle the heavy reels of cable stored on the first floor a crane

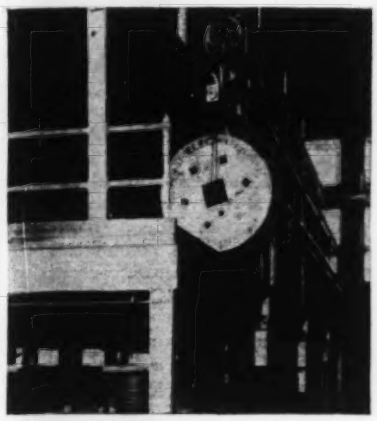


Fig. 3—Provision for handling cable reels by an overhead crane in the central bay determined the setback construction of the building.

capacity of 10 tons was required. The crane loading conditions were the dominant factors in the location and design of interior columns, although the floor loads contributed substantially to the loads applied to the lower sections of the columns. The horizontal reactions of the crane girders were cared for by four 3-in. by ⅜-in. fillet welds on the girders and also on the angle clips welded to the roof columns (Fig. 1). The crane rails were welded to the crane girders by 2½-in. by ⅜-in. fillet welds placed on both sides of the rail and spaced 2 ft. on centers. In Fig. 1 are also shown the offset framing at each floor and typical beam-to-girder connections, with the necessary shim plates required to bring the tops of the beams to the proper level to receive the 4-in. floor planks. Although the beams rested on the girder flanges, the welded connections were designed to carry the full load. In the beam-to-column and girder-to-column connections, seat angles were shop-welded to the columns. The arrangement of seat angles between the flanges of the columns (Fig. 1) was developed by the American Bridge Co. and proved very satisfactory.

All embedded steelwork prior to laying of brick was painted with one coat of aluminum. All exposed steelwork in the interior of the building was also given a coat of aluminum paint.

The steel was fabricated in the shop by the American Bridge Co., while fabrication at the site, erection of steel and field-welding was sublet by the American Bridge Co. to Leake and Nelson, Inc., Bridgeport, Conn. The general contract was carried out by the Pardy Construction Co., Bridgeport, and supervised by H. A. Hagadorn, plant engineer, Bridgeport plant, General Electric Co.

Concrete in Old Outfall Sewer in Good Condition After Twenty Years

By **Milton J. Ruark** and **C. E. Keefer**
Formerly Sewerage Engineer and Principal Assistant Engineer, Respectively, Bureau of Sewers, Baltimore, Md.

NO DISINTEGRATION of the concrete in the Baltimore outfall sewer was discovered when it was examined recently after having been in service twenty years. Tests on concrete specimens taken from the old sewer showed an average crushing strength of 3,745 lb. per sq.in.

The outfall sewer is 12 ft. 3 in. wide by 11 ft. high. It was built in 1908 and is of 1:2:4 concrete mixed by hand. The coarse aggregate consisted of gravel. In the latter part of 1911 the first sewage flowed through the outfall, and it has been in continuous service since then.

In the summer of 1931, when it became necessary to cut into it to connect a concrete sewer 6 ft. wide by 4 ft. 8 in., an opportunity was afforded to make a thorough examination of the concrete. The results of this examination indicated that the concrete in the sewer is in excellent condition, and that so far as can be ascertained no difficulties need be expected from the disintegration of the concrete arch because of hydrogen sulphide, or that the sewage will be harmful to the concrete below the flow line.

Considerably more than 1,000 miles of sanitary sewers are now tributary to the outfall. The sewage coming from the extreme ends of the system flows through about 14 miles of sewers, with an estimated time of flow of from seven to eight hours. The outfall, designed to carry a maximum flow of 291 m.g.d., now has an average flow of 60 m.g.d. with a velocity at times considerably less than 2 ft. per second. At the point where the outfall was broken into there was about 12 in. of sediment on the bottom. Although there was a strong odor present, the sewage contained traces of oxygen, which indicated that the sewage was in a stale rather than in a septic condition.

STRENGTH OF CONCRETE SPECIMENS TAKEN FROM OUTFALL SEWER, BALTIMORE

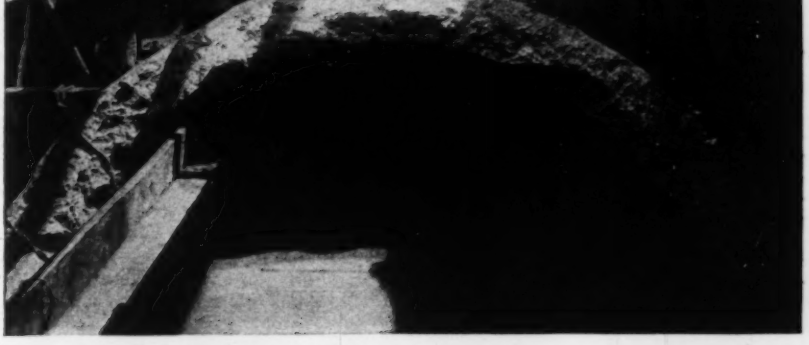
(Built in 1908 and put into service in 1911)

Place in Sewer From Which Test Specimen Was Removed	Ultimate Compressive Stress Lb. Per Sq.In.
Top	4,065
Top	3,475
Side	3,150
Side	3,700
Side (below flow line)	3,610
Side (below flow line)	4,190
Side (below flow line)	4,025

The whole side of the outfall sewer together with the top was broken out for a distance of about 21 ft. The concrete was in excellent condition with no traces of disintegration. Eight large samples of the concrete were removed and tested. The ultimate compressive stress in these samples at failure varied from 3,150 to 4,190 lb. per sq.in., with an average of 3,745.

The results of the examinations and the tests indicate that concrete is well adapted as a material for large sewers in Baltimore.

Arch of the twenty-year-old outfall sewer at Baltimore in which concrete was found unaffected by sewer gases.



Reducing the Flood Menace by Preventive Action

Steps can be taken at little or no cost to check the growth of hazards—Publicity, administrative control and long-range planning are essential elements

By C. A. Bock
The Dayton Morgan Engineering Co., Dayton, Ohio

FLOOD HAZARDS grow from year to year, the author points out in the following article. If the 1913 Central States flood were repeated today, it would produce losses many times as great. It is possible to prevent the creation or growth of flood dangers by local action directed by a state water-resources board. —EDITOR.

FREQUENT CONTACT with flood situations suggests a most important phase of the flood problem that rarely receives more than passing notice and too often is entirely neglected. Many flood situations are permitted, by needless and preventable developments, to become continually more dangerous and more costly, if not wholly impossible of correction. Proper watchfulness can forestall this increase of menace at little or no cost.

In many states, as in Ohio, there is no public authority to control the development of private property as affecting floods, except in areas that have been organized under special improvement district laws. Private property rights permit almost unrestricted use of river banks even in the case of large streams in populous communities. Bridges, buildings, walls and embankments rise not only on the flood plain but frequently in locations where they encroach on the low-water channel. Major structures, once built, have a heavy influence on later planning. The real estate developer, knowing little of river hydraulics, gives more attention to construction economies and immediate profits than to flood possibilities. Railroads, industries and highways have been heedless invaders of the flood plains, and in some cases they so completely surround a dangerous river that flood protection becomes expensive or impossible.

Danger rarely appreciated

Damage suits have in recent years helped somewhat to check this disregard of flood problems. On the other hand, most city administrations are asleep to flood situations or appreciate only vaguely the danger until they are awakened by the shock of a great flood. So complete is this unawareness that cities not only permit objectionable development within their limits but are themselves often guilty of constructing inadequate sewers, waterways or bridge openings. Examples of such inattention are available on every hand. A typical situation (from the reports of the army engineers) is noted in a finding regarding a certain river that "the flood situation is considerably aggravated by the existence of fourteen bridges which unduly obstruct the river channel and flood plain."

Of course, great floods do not come frequently. Also, no hard and fast rules can be laid down for preventing flood obstructions. A single structure may have no appreciable effect on the natural floodflow, but when the number of structures is multiplied so as to fill the flood plain completely the aggregate obstructing effect may be very great. Thus the menace grows impreceptibly from a negligible beginning, and it is not an easy matter to determine at what point a halt should be made. An accumulation of obstructions over a period of, say, twenty years may bring about a material reduction of the river's flood capacity. In Ohio, for instance, the common measure of a great flood is that of 1913. While it is readily conceded that such a flood may come again, few flood cities take serious cognizance of the fact that its repetition now would exact a much greater damage toll, due to encroachments.

Publicity, control and plan

There is great need for flood-control works in many places where the cost of protection is at the present time clearly beyond the resources of the community and where part protection would be inadvisable. The answer to these situations should not be one of hopeless abandonment, deliberate neglect or blind refusal to recognize the problem. The remedy must be found in forward-looking planning and administrative control. The writer would suggest three essential elements for progress in this direction; publicity, administrative control and long-range policies.

Public officials and civic bodies are often reluctant to attract attention to the flood menace. The seeming triviality of a single encroachment robs it of news value, as does also the fact that it requires an expert for its correct interpretation. Nearly all private developments are undertaken for quick results rather than for profit a generation hence. These and other influences tend to discourage publicity of flood conditions, except in the case of destructive floods.

The newspapers, however, afford a powerful agency for directing attention to flood-prevention planning for the future. As a rule they do not hesitate to indorse sound policies promising future benefit. Engineering periodicals and magazines dealing with municipal matters would help. Planning for the future in civic matters is now so common that it should not be difficult to enlist some interest in this aspect of flood problems. Local engineers can help to formulate and direct the attitude of civic organizations.

Control is esssential

A serious difficulty in many communities is the lack of competent advice as to a suitable plan, and small cities are rather helpless without some authoritative agency for general guidance. This need has already been met by a number of states. A notable example is the Water and Power Resources Board of Pennsylvania. It cooperates with federal and local agencies in compiling water resources information and related basic data. Under a carefully drawn administrative code it has authoritative control over any construction or operation that may affect the natural flow of streams. It provides definite regulatory supervision over such structures as dams, spillways, bridges and canals and has power to establish official bank lines to limit encroachments. It maintains a technical staff suitable for administering these functions. The construction of bridges that constitute a flood menace is not easily possible in Pennsylvania.

An early and rather unique example of administrative control of streams is that of the California Debris Commission. Its duty was to restrict or regulate the discharge into streams of enormous quantities of hydraulic mining debris. A number of other Western states have long maintained some regulatory supervision of streams, especially regarding irrigation matters. In the East the approach to administrative stream control has naturally centered more around the needs of sanitation, and domestic and industrial water supply.

It is believed that other states could with profit adopt some such plan of coordinated control and guidance as that now operating in Pennsylvania. For instance, the Ohio highway department is now engaged in a bridge-building program calling for 292 structures at an aggregate estimated cost of $3,500,000. This job was thrust upon the department suddenly. The bridge engineers would undoubtedly have welcomed the assistance of a "water resources board," which could unhesitatingly assume the responsibility of fixing sizes of bridge openings, having ready at hand the basic flood data and a knowledge of requirements for flood-control plans. Conservancy districts in Ohio may assume this function under the Conservancy Act, but their authority

does not extend beyond their individual areas.

Such control does not necessarily mean an expensive organization. Its personnel can be adjusted to the needs of the situation, and the saving it effects should be much in excess of its cost.

Develop a long-range plan

An adequate policy for the administration of streams cannot be formulated at once but must be developed by growth. The basis for its development must be a knowledge of the streams and their flood problems, general plans for meeting those problems and authoritative control and supervision over constructions affecting floodflow. A state control board, as in Pennsylvania, which would coordinate existing data and supplement them where desirable, could furnish such a basis. Its function would not be that of a consulting engineer but that of a public agency supplying public information that can be effectively collected only by such an agency; it would also act as an administrative authority prescribing general policies that it has power to enforce. It could, as an agent of the state, deal with interstate water problems or questions with the federal government, as these arise.

Tentative general plans are necessary for the orderly development, use and control of our water resources to avoid waste and conflict of purposes. Such plans should help to forecast future problems and needs and should consider conflicting interests. The use of a reservoir site for flood control, for instance, may prevent its use for power, for water supply or for recreation purposes. The state is warranted in exercising some control over such constructions. Huge sums have been wasted on flood-control works lacking comprehensive planning.

Losses reach millions

Tangible flood losses in this country during the past ten years, as reported in money value in the climatological data of the U. S. Weather Bureau, amount to $400,000,000. These losses are increasing with the increase of population and development. It is not always financially feasible to control floods. Increase of the flood danger is gradual but persistent. In many cases it is possible to prevent further increase. It is also feasible to conserve and improve possibilities for future flood protection.

The three essentials for meeting this problem are publicity, planning and authoritative control. It is believed that these essentials can best be provided by establishing a water resources board in each state, charged with administrative control and continuing supervision over the streams of the state. This board would set up policies for long-range, coordinated planning. The cost of such work would be amply justified by the benefits.

Two Unusual Grade-Separation Structures in Utah

In one, rolled 36-in. beams are used in unusual lengths of 93 ft., cantilevered over piers at ends—Second structure is a wye and utilizes concrete T-beam construction with stems and slab poured separately

By Maurice Housecroft

Bridge Engineer, Utah State Road Commission, Salt Lake City, Utah

LAST YEAR witnessed the completion of two grade-separation projects in the state of Utah that involved some unusual features. The first of these, built over the Los Angeles & Salt Lake Railroad near Tooele, Utah, was located at a point where the tracks were in a cut in order to take advantage of the reduced highway embankment quantities. For good alignment the angle between the highway and railroad was only about 37 deg. The side clearances required by the railroad company for the present single track and a probable future track, together with the increased length due to the flat crossing angle, necessitated a center span of 68 ft. This length of span would normally require a low truss or plate girder if it were designed as a simple span. In studying the type to use, it was found that approach spans using piers would be considerably less costly than abutments for a truss or girder span. Further analysis of the superstructure indicated that by extending beams for the center span over their supports to develop a cantilever a much smaller section would be required, since the bending moment created by the cantilever proportionately reduced the positive bending moment in the beams for the center span. This arrangement would also permit much shorter simple spans for the approaches. Projecting the beams over the supports away from the tracks placed the supporting links outside the track area, removing the necessity for any falsework near the tracks either during erection or subsequent repair work. Examination disclosed that the section modulus required was well within the range of rolled wide flange beams, which are available in special lengths at slight extra cost.

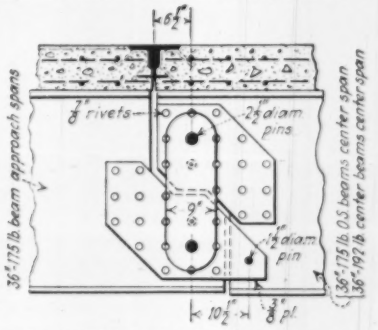
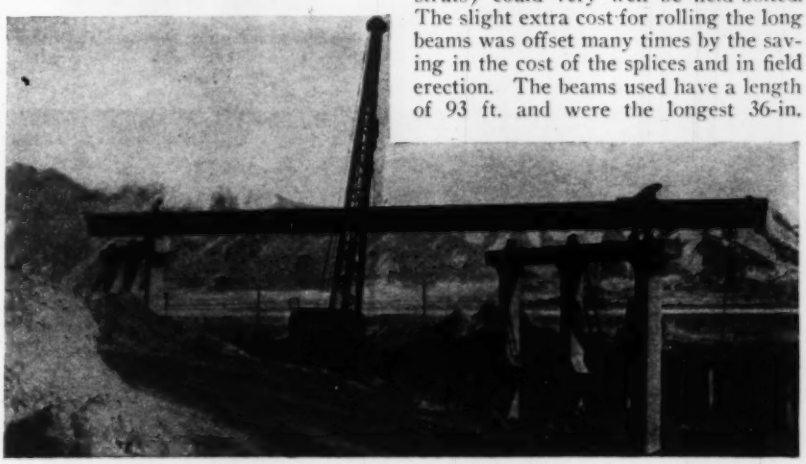


Fig. 2—Link connection between center span and side-span beams at cantilever support on Tooele overcrossing.

This type of design, therefore, was adopted. It was decided to design the beams for the middle section without splices, thus eliminating the necessity for a field riveting crew, since the only field connections (beam spacers and end struts) could very well be field-bolted. The slight extra cost for rolling the long beams was offset many times by the saving in the cost of the splices and in field erection. The beams used have a length of 93 ft. and were the longest 36-in.

Fig. 1—Locomotive crane placing 10-ton 36-in. rolled beam 93 ft. long in grade-separation structure over Los Angeles & Salt Lake Railroad at Tooele, Utah. Crane erected three beams of this type in 22½ min.



Carnegie beams that had been rolled up to that time.

The end spans were supported by means of link bars and turned pins with chambered nuts. Hinged bearings and rockers were provided at the bridge seats so that free movement might be obtained, the hinges eliminating any overstress, due to deflection of the beams, in the front of the bridge seats.

Erection of the beams proved very simple, a locomotive hoist setting all three beams in the center span in 22½ min. The erection of the beams in the approach spans proved equally simple by booming out and holding the beam in place until the pins in the hinge or toggle bars could be driven.

The substructure, as shown in the accompanying illustrations, is of the open type, and the end bents permit the approach fills to run between and around the columns. The intermediate bents consist of three columns, one centered under each of the three beams in the superstructure. These columns are tied together transversely by the cap and footing and by a tie beam at about half the height.

The total cost of this structure was less than $20,000, or about $96 per foot. The contractor was Christensen, Gardner, Inc., of Salt Lake City, and B. W. O'Toole was resident engineer for the highway department.

The second structure, a wye in plan and of concrete T-beam type with column bents, was built over the Denver & Rio Grande Western Railroad near Thistle, Utah, at the junction of U. S. highways No. 50 and 89, U. S. 50 being a trans-state highway between Colorado and Nevada and U. S. 89 extending south to Arizona. In Fig. 3 highway No. 50 parallels the tracks along the north side of the bridge, while highway No. 89 crosses the bridge.

The complications in the design and layout for a structure at this location were increased by the close quarters encountered. To the north was a high rock bluff through which the Utah Railway had partly driven a tunnel on its uncompleted construction. At the foot of this bluff was Soldier Creek, with the railroad tracks immediately to the south. This rock bluff and the location of the uncompleted grading and tunnel, therefore, were control features affecting the

Fig. 3—Wye-shaped grade-separation structure over D.&R.G. tracks at Thistle, Utah, is located at intersection of U. S. routes 50 and 89.

distance that the line for U. S. 50 could be placed to the north. Consequently in order to provide adequate space for Soldier Creek, a fill had to be constructed of hand-placed rock on a 1-to-1 slope. By this procedure it was possible to provide a 36-ft. span for the creek. The main span over the three railroad tracks was made 50 ft. center to center of bents and provided with a 23-ft. vertical clearance. The next span to the south has a span of 33 ft., and the south span of 34 ft. The latter was designed as an X-braced frame, and the major portion of the bracing was buried in the approach fill.

The radii for the wye curves are 100 ft., which normally requires considerable superelevation on the roadway surface for comfortable riding qualities. The gradient on U. S. 50, as it approaches U. S. 89, is 6 per cent in both directions, with the vertex of the grades and the crest of a 500-ft. vertical curve at the intersection of the center line of U. S. 89. The superelevation for the entire wye and the roadway crown for the rest of the structure was, therefore, obtained by horizontal projection of the 500-ft. vertical curve, which very materially simplified construction by having all roadway elevations proportional to the distance from center line.

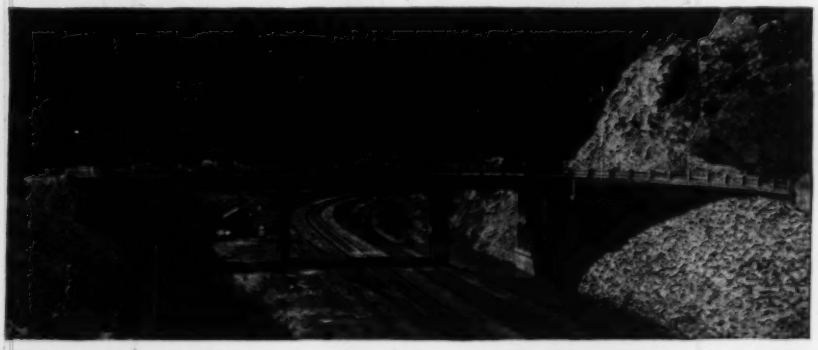
Due to the necessity of carrying the footing of the pier between the tracks and the creek to an elevation that would be safe from scour, and the necessity of maintaining traffic on the track farthest north, a temporary pile trestle had to be placed for the railroad, to prevent it being undermined before excavations for this pier could proceed.

Construction of the falsework for the main span No. 3 over the tracks proved to be a problem, for no interruption of railroad movements was permitted and no supports were to be allowed between the main-line tracks, although supports could be placed between the center track and the siding. This condition required two unequal spans of falsework, with resulting variations in deflections. Two lines of 8x18-in. timbers were placed under each beam, and between the timbers and the forms a series of wedges was placed to permit correction for deflection as pouring proceeded.

To obtain minimum encroachment on the vertical clearance over the tracks during construction, it was necessary to reduce to a minimum the amount of dead load on the falsework stringers. Therefore, the beams were poured first and carefully cured for three weeks before the pouring of the slab was begun. Since T-beam design requires that the slab and stem operate as an integral unit, transverse keyways were formed between each set of stirrups, thereby forming out approximately half of the concrete in the upper portion of the beams between the haunches. When these key forms were removed and the slab poured, adequate provision was provided for the horizontal shearing stresses between the slab and stem. The stirrups extending into the slab were an added precaution.

The structure involved 1,138 cu.yd. of concrete and 205,000 lb. of reinforcing steel. It was built by the Utah Construction Co. at a cost of $38,000. George W. Kinney was resident engineer for the highway department.

Fig. 4—Fill carrying highway along bank of creek at right had to be hand-placed, so as not to encroach on streambed. D.&R.G. tracks are accommodated beneath a 50-ft. span with 23-ft. vertical clearance.



Arresting Abutment Shifting on a Bascule Bridge

Double-leaf structure in Toledo repaired by concrete substructure that increases foundation bearing and includes struts in the river bottom bracing the abutments apart

By Orrin H. Pilkey
Waddell & Hardesty, Consulting Engineers, New York, N. Y.

SETTLING and shifting of the abutments riverward on the double-leaf bascule crossing of Swan Creek on Summit St. in Toledo, Ohio, impaired the efficiency and threatened the safety of the structure to such an extent that a major repair job was necessary. The plan adopted was unusual in several particulars and included extending the bases of the abutments and installing three concrete struts entirely across the river in about 16 ft. of water, to prevent the abutments from moving closer together.

In the bridge which was built about 1920-1922 four longitudinal girders support a 50-ft. roadway with two trolley lines, and two 15-ft. sidewalks. The span center to center of bearings is 90 ft., and the radius of the rolling segment is 7 ft. Originally, all the substructure was supported on timber piles.

The need for repair and strengthening became apparent when it was discovered that both the south and the north abutments had moved riverward. This movement appeared to be of three kinds: (1) A horizontal drift of the two abutments toward each other, totaling about 0.9 ft., the greater part of this being due to the shifting of the south abutment; (2) a riverward tilting of slightly more than 1 deg.; and (3) a vertical settlement of an undetermined amount but of more than 1½ in. When the excavation for the new construction exposed the front row of piles under the south abutment, it was found that they were only from 8 to 12 ft. long, whereas they should have penetrated to a much greater depth in order to transmit the load properly.

The shifting of the abutments had extended over a period of years and had resulted in frequent jamming at the center of the bridge. On several occasions this jamming was remedied, and the bridge was put back into operation by cutting off the ends of the bascule leaves. At one time it was also found necessary to refabricate the lock at the center. These expedients, however, proved to be temporary, and the movement continued.

After a preliminary survey it was obvious that before the ends of the leaves were cut off again steps must be taken to prevent further movement of the abutments. If this could not be done satisfactorily and economically, there would be the alternative of tearing out the old bridge and constructing a new one. The repair plan adopted, it is believed, has checked further displacement of the abutments and possessed the additional advantages of (1) costing considerably less than a new bridge, and (2) interrupting traffic for a minimum length of time.

The first remedial measure was to drive new piles into the riverbed, adjacent to the toe of each abutment. Then each abutment was given added support by resting it on a continuous concrete bracket cantilevered under its toe, this bracket in turn resting on the newly driven piles.

To prevent further horizontal movement, three struts were inserted between the abutments to hold them apart. The tops of these struts had to be about 16 ft. below normal water level in order to permit the passage of river traffic. Since the bottom of each abutment was only 12 ft. below normal water level, these struts were framed into the extension of the base instead of bearing against the abutment itself. It was necessary, therefore, to provide the extension of the base with a bearing surface in front of the abutment as well as under it. This was accomplished by constructing the new section 3 ft. up the face of the abutment and 3½ ft. under the toe.

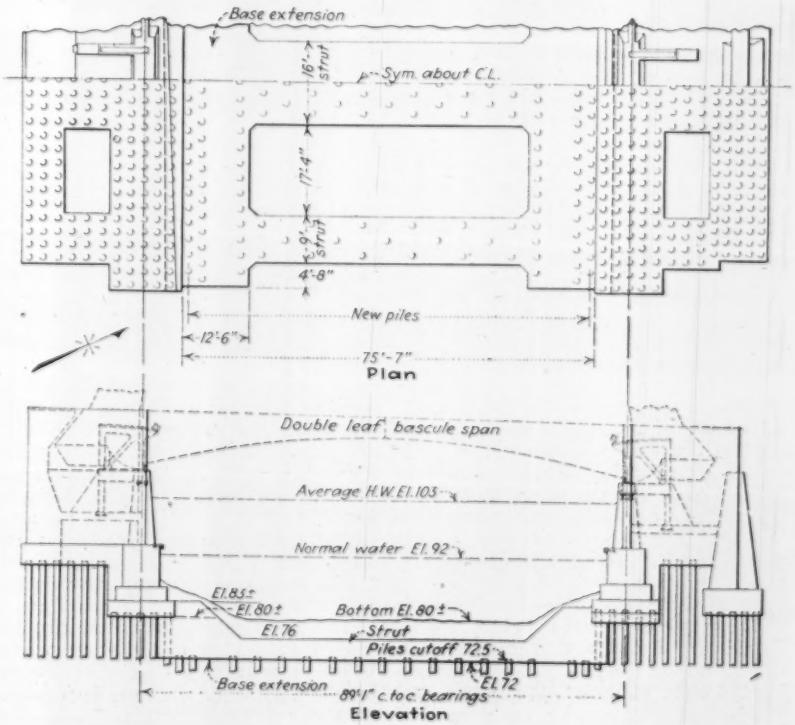
The resulting structure is shown in the accompanying illustration. It consists of a concrete framework in the bed of the stream, formed by the two brackets (or base extensions) parallel to the channel, one supporting each abutment; and three struts at right angles to these, holding them apart, the whole having the shape of the Roman numeral III. The entire unit is supported on piles.

Due to the width of the new extensions of the bases, the struts are only about 51 ft. long, whereas the distance between the toes of the original abutments is about 76 ft. The struts are of unequal cross-section, the center one being 16 ft. wide by 4 ft. deep, while the two outer ones are 9 ft. wide by 4 ft. deep.

Upon completion of the substructure the following steps were taken to insure the proper functioning of the superstructure.

1. The ends of the stringers, girders and curb angles were cut back to give a minimum clearance of about 1½ in.
2. The locks were partly dismantled, and the supporting structural material was relocated.
3. Floor dams of 12x12-in. timbers

Base extensions and struts used to eliminate vertical and horizontal movement of the abutments of the Summit St. bridge at Toledo, Ohio.



were placed at the break between the two leaves, providing a smooth riding surface over the joint.

When the size of the bridge itself is considered, the 1,062 cu.yd. of concrete required in the repair work is notable. This job was completed at a contract price of slightly under $70,000. The work was done at the direction of William H. Schroeder, who is at this time director of public service, Toledo, Ohio, by Waddell & Hardesty, consulting engineers, New York, N. Y. The contractor was the A. Bentley & Sons Co., Toledo.

The writer assisted in making the plans in the New York office of the consulting engineers.

Increasing the Bearing Power of Clay Soil

By Daniel E. Moran
Consulting Engineer, New York City,
and F. O. Dufour
United Engineers & Constructors, Inc., Philadelphia, Pa.

RECENTLY a 9-in. reinforced-concrete floor with an area of about 55,000 sq.ft., resting directly on the soil and with roof posts spaced about 20 ft. on centers each way, was found to be settling. The floor carried a load of 1¼ tons per square foot. The reactions of the roof posts were in some cases 5 tons, even when snow was not considered.

The foundation soil consisted of clay and a decomposed rock that contained a quantity of flats that felt somewhat like soapstone. Part of the floor slab was on original soil and part was on fill placed in 8-in. layers, each rolled with a 4-ton street roller and a crawler crane weighing 8 tons. The exterior walls of the structure were on a continuous foundation wall carried down to rock.

In order to determine the amount of settlement, the floor was unloaded and levels were taken. It was found that about a fourth of the floor area had settled and that this was in all cases over the fill; the maximum settlement was 8 in. It was then determined to bring the floor back to its normal position.

The nature of the soil was thought to be such as to preclude the use of grout forced in through well points. One well point with grout at 100 lb. per sq.in. was tried with no positive results.

The use of the special mud jack for road-slab raising was considered, as a means of restoring the floor slab to proper level, but the machine was not immediately available, and in any case it would have interfered with certain parts of the structure. Instead a small grouting machine was utilized. This machine had a 4-cu.ft. capacity and worked with 100-lb. air pressure. Trial showed that a charge of 2 cu.ft. of 1:2 mixture with 7 gal. water, making 2.4 cu.ft. of grout set in place, was the leanest mixture that could be used without clogging the machine. Through a 2-in. hose the grout was injected below the slab by way of holes cut in the slab.

With a crew of three men at the grouting machine and two men at the hose, grout was injected at the rate of 200 batches, or 480 cu.ft., per twelve-hour day. Holes were spaced about 10 ft. on centers, and those not in use or those recently grouted were sealed with burlap wads loaded with two sand bags.

The operation was a complete success. The slab was raised quickly to its original elevation, although due to the unequal elevations of the floor there was sometimes found to be as much as 10 tons (estimated) on certain of the posts.

In order to prevent further settlement, the question of compacting the fill below the floor slab was then considered; and it was decided to use the Francois cementation process used in this country by the Dravo Contracting Co. In this process a special grout pump, capable of exerting pressures up to 3,000 lb. per sq.in., forces neat grout through an armored rubber hose to the location to be grouted, which may be hundreds of feet from the pump. At the grouting location the hose is attached to a special head on a 2-in. pipe open at the other end. This pipe may be 50 ft. or more long; it is driven as deep as desired, is cored out with an auger, and the required grout is then forced in.

The grout so introduced did not set up over a period of 72 hours, probably due to the clay soil preventing sufficient air getting to it quickly. In order to accelerate the set, an admixture of baking soda was introduced, 1 lb. per bag of cement, resulting in a reduction of the settling period to about fifteen hours.

The complete procedure in this case was to cut holes approximately 7½ ft. on centers both ways, insert the grouting pipe 4 ft., and grout until neat grout to the amount of 50 bags of cement had been forced in, or until the floor started to rise or refusal was reached. This was expected to have formed a bulb at the end of the grout pipe. Before this dose of grout was set (and it took fifteen hours for this to occur), a hole was drilled through the grout and the process repeated. A second bulb was then expected to have been formed. Before this second dose of grout was set, a smaller pipe was driven inside the 2-in. pipe and through the grout to rock, which lay at a maximum of 12 to 16 ft. below the floor. This pipe was withdrawn 12 or 18 in. and cored out with an auger, and the lower part of the hole next to the rock was tamped. The grout was then forced in as in the other two operations; but it is of interest to note that as a result refusal came or floor movements occurred after only ten to fifteen bags of cement had been used. Both pipes were cut off and the hole was sealed.

During the work with the heavy-duty grouting machine a test hole was sunk near one of the grouted holes where grouting had been completed, in order to determine just what form the grout took when set. It was found that instead of forming bulbs, the grout had spread out in layers 1 to 3 in. thick, presumably in the cleavage planes formed by rolling the fill in layers. As inspection of the test pit showed incipient bulbs at the ends of the grout pipe, it is surmised that if the fill had not been placed in layers, large bulbs would have formed and the soil would have compacted accordingly. It is also surmised that higher pump pressures would have been obtained.

The following is the yardage, in place, of grout injected:

By grouting machines, cu.yd.	420.0
By high-pressure pump, cu.yd.	183.3
Total	603.3

An estimate based upon the original borings and surface elevations showed the fill to have been compressed 14.5 per cent. From the results of soil tests on both 1 sq.ft. and 4 sq.ft. bearing areas, with pressures up to 4 tons per square foot, both before and after the grouting, it was judged that the 14.5 per cent compression obtained was sufficient to prevent further settlement of the foundation.

Since completing the job, the floor has at times had its full load of 2,500 lb. per square foot over its entire area, and this has remained for several months. Levels taken have showed no appreciable settlement.

Experience gained in this work suggests no change in procedure except that if it is important that the floor should not be raised above its original level, the high-pressure subsoil injection should be done before the slab is raised by the grouting machines. If this is not done, the final elevation of the floor may be slightly above its original elevation, since in the cementation work the stopping time for any particular injection operation is often fixed by noting that the surrounding floor is beginning to rise.

Building a Water-Supply Unit From Intake to Filters

In first unit of 42-m.g.d. development for New Jersey communities, river structures serve doubly as weirs and conduits—Non-pressure filter underdrains of perforated half-round cast-iron pipe—Pressure line of 48-in. cement-lined cast-iron pipe

By Franklin Hudson

Sanitary Engineer, Amburgen Construction Co., Inc., New York City

FORESIGHT in waterworks planning for rapidly growing communities, combined with construction in units to meet increasing consumption, is exemplified by Mr. Hudson's description of intakes, treatment and pumping plants developed by a water company in New Jersey. As often happens in such cases, a part of the work has to be ample at the outset for the full projected supply—in this case, a conduit built within a dam. —EDITOR.

DOUBLE diversion weirs, intakes with reversible flow possible, large unbaffled subsidence basin, flexible arrangement of coagulation basins and non-pressure half-round filter underdrains are some of the more unusual features of the recently constructed 10.5-m.g.d. water-purification plant built by the Elizabethtown Water Co., Consolidated, above the confluence of the Raritan and Millstone rivers, near Bound Brook, to serve several communities in eastern New Jersey.

The total drainage area above the intakes is 750 square miles, 300 of which is on the Millstone. Nearly 20 per cent of the Raritan area is cultivated highland and trap-rock ridges, while the remainder is a low sandstone plain. Sand hills are the source of the Millstone River, and the flow is generally through sandy soil, thus insuring a large ground storage. Complete development of the project will use only 50 per cent of the minimum flow of the streams.

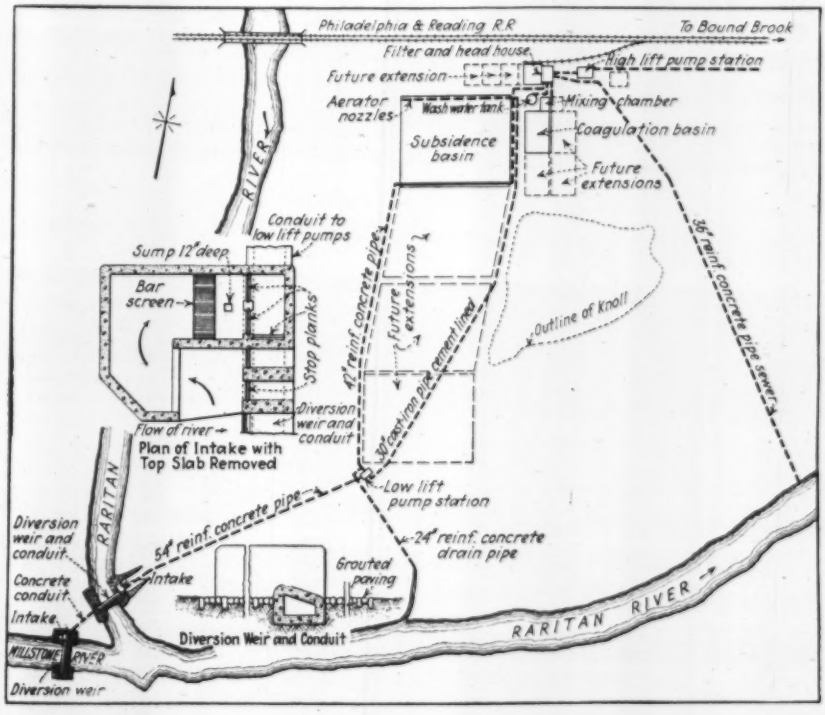
The diversion weirs and intakes on each river are located 200 ft. above the junction of the streams. The Millstone weir is a solid concrete spillway structure diverting water to the intake on the left bank. A 3x5-ft. concrete conduit connects this intake with the Raritan weir. This weir, of hollow construction, serves as a conduit to carry the raw water across the Raritan River. The conduit has a cross-sectional area sufficient to provide a velocity of about 5 ft. per second when the flow is 42 m.g.d., the ultimate development.

Two reinforced-concrete intakes located in the left bank of each river draw the supply at right angles to the flow of each river. A complete reversal of flow is also provided for, as shown in the plan, before the water passes through the bar screens. Double sluiceways are provided with stop planks at the entrance to each intake, so that silt and trash can be bypassed directly downstream of the diversion weirs. The bar screens are of 3x$\frac{3}{4}$-in. wrought-iron bars spaced on 1$\frac{1}{4}$-in. centers. These screens are set on a slope of 0.6 horizontal to 1 vertical. With the water level at an average depth over diversion weirs, the net velocity through the screens will be slightly more than 1 ft. per second for the ultimate capacity of the plant. At present all water for the plant is taken from the Millstone River.

The present construction includes both low-lift and high-lift pumping stations together with a 10.5-m.g.d. water-treatment plant, the latter providing five distinct operations—subsidence, chemical treatment, coagulation, filtration and chlorination.

QUALITY OF WATER BEFORE AND AFTER TREATMENT

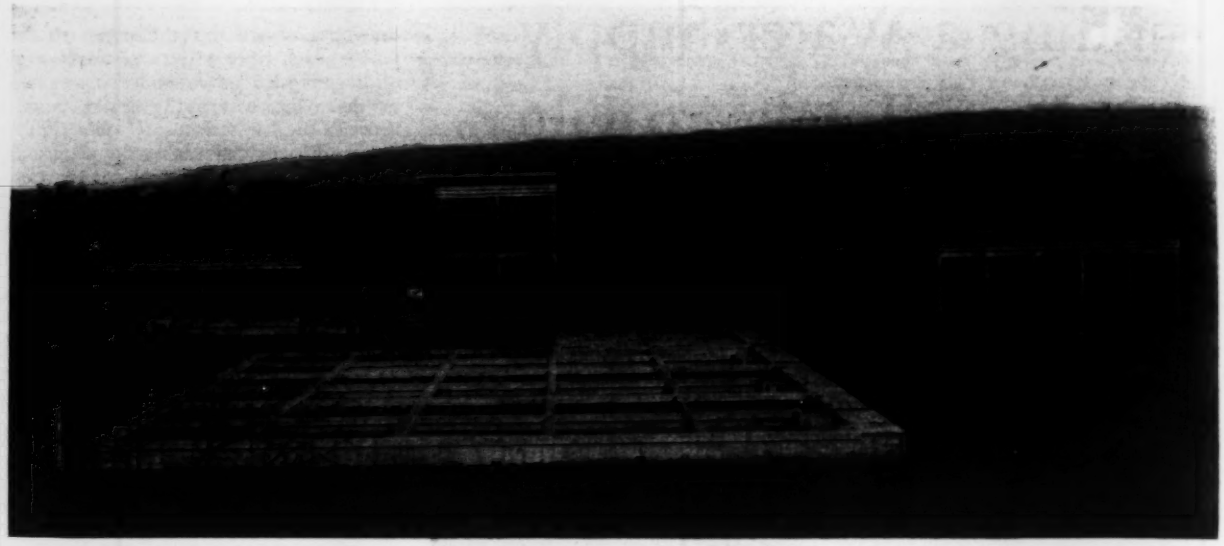
	Raw Water (Average Condition)	Raw Water (Worst Condition)	Filtered Water (Average Effluent)
	Parts Per Million		
Color	25	45	1
Turbidity	10	195	0
Odor	1E	3E	No
CO_2	4	9	0
pH	7.0	6.5	8.5
Total hardness	42	47	50
Alkalinity	20	6	20
Total solids	130	250	125
Organic and volatile	45	130	40
Mineral matter	85	120	85
Iron	0.1	2.0	0
Carbonate hardness	20	6	20
Non-carbonate hardness	22	41	30



Raritan-Millstone water-supply development is a completely new installation from headworks to high-lift pumps.

The low-lift pumping station, 25x42 ft. in plan, having a well 25 ft. deep, receives the raw water from the river intakes through 950 ft. of 54-in. reinforced-concrete pipe. The design provides for two traveling screens. However, for the present only one screen has been installed. This screen is of hard-drawn copper-wire mesh having $\frac{1}{8}$-in. clear openings. To effect more satisfactory treatment of the water, an addition of two chlorinators and an ammoniator has been made directly behind the screens. At present an average of 0.75 p.p.m. of chlorine and 0.25 p.p.m. of ammonia is being added, with the result that tastes and odors have been satisfactorily reduced. Two 7,700-g.p.m. vertical centrifugal pumps designed to pump against a total head of 50 ft. are located in the pump room. These pumps are operated by vertical motors of 150 hp. located on the operating level. These are of the synchronous type, designed to operate with a constant speed.

The 42-in. reinforced-concrete pipe line that drains the subsidence basin is



Filters and head house are behind the washwater tank, baffled coagulation basins are in the foreground, and high-lift pumping station is at right.

connected to the pump suction, so that the entire contents of the settling basin can be pumped directly to the coagulation basins in times of emergency.

Aeration of the raw water is accomplished by passage through 30 bronze nozzles inserted in a cast-iron pipe suspended on brackets along the top of the north wall of the settling basin. The nozzles discharge into the basin under 5-lb. pressure at an angle. The pipe is graduated in size from 24 to 12 in. and is provided with blowoff valves and bleeder holes. An 8-ft. louver fence of cypress, located behind the nozzles, prevents spray from blowing over the wall.

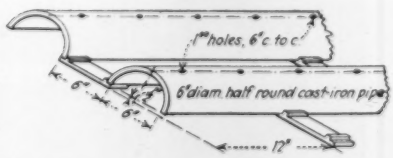
A settling basin, 350x450 ft. in size, with a capacity of 20 m.g., provides two days' retention for normal operation of the plant. The main walls, of cantilever type, are backed by an earth embankment to within a few feet of the top. The settle-water effluent conduit, which is located directly across the basin from the aeration nozzles, has inlet ports 4 ft. below the water surface. The outlet chamber for normal operation has a sluice gate that opens down, thus providing an adjustable weir for control of the flow. Auxiliary effluent ports, 12 ft. below the normal surface, discharge into a conduit that leads back to the low-lift pumping station for emergency use. It was necessary to construct a portion of the main walls of the basin on piling, and along the east end of the basin the floor was built on a small amount of backfill. After first filling the basin, several cracks developed, and it was necessary to provide additional asphaltic joints and to waterproof the floor partly with a three-ply membrane to eliminate leakage.

Chemical application is made as flexible as possible. Settled water from the subsidence basin flows through a 48-in. reinforced-concrete conduit and a 48x24-in. venturi meter to a rectangular contact chamber under the chemical feed room. This feed room, which is located in the filter head house, contains two chemical dry-feed machines and one combination dry and solution feed machine, both of which feed directly into the contact chamber. The machines are designed to operate with ground sulphate of alumina, hydrated lime or soda ash. The combination dry and solution feed machine is also connected to the filtered-water conduit to make final correction in alkalinity and pH. Concrete hoppers, located on the second floor of the head house, where chemical storage space is provided, are connected to the chemical machines by dust-proof ten-gage steel-plate hoppers. Average conditions require the use of about 143 lb. of alum, 100 lb. of lime and occasionally about 75 lb. of soda ash per million gallons. An improved taste in the treated water has been secured by the addition of about 4 lb. of activated carbon per million gallons.

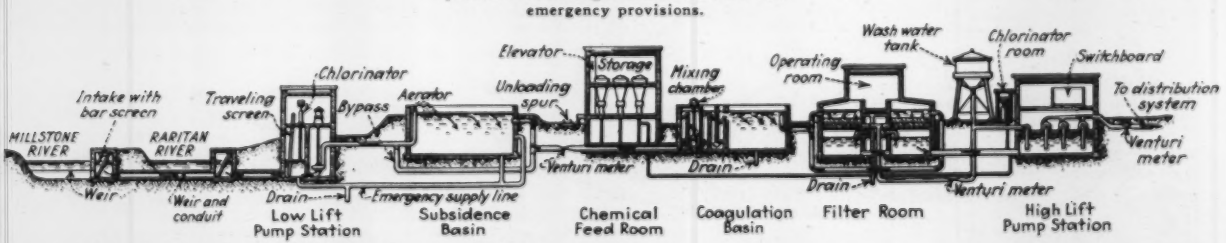
Mixing chambers, two in number, each 50x19 ft. in plan and with a water depth of 15 ft., receive the treated water from the contact chamber under the chemical feed machines. A retention period of 30 min. is available for mixing the water both by a vertical-flow agitation and an over-and-under baffling. The two mechanical agitators, driven by 2-hp. motors in weatherproof copper housings, consist of bronze propellers operating in short sections of 14-in. cast-iron pipe set near the floor of each basin.

Coagulation basins provide four-hour detention periods for coagulation in three basins, each 100x54 ft. in plan and having a 15-ft. water depth. The basins and both influent and effluent conduits are so constructed that individual, multiple or series operation can be ob-

The non-pressure underdrain of half-round cast-iron perforated pipe is laid on lug spacers.



Flow sheet diagrammatically traces the water throughout each structure and process. It also gives the alternate and emergency provisions.



Arrows indicate direction of flow for normal operation

Aeration nozzles in distribution pipe on north wall of subsidence basin.

tained by the use of wooden stop planks set in cast-iron frames. Each basin is of conventional design with main walls reinforced vertically, the lower reaction due to water pressure being taken by the floor slab and the upper reaction resisted by a horizontal coping beam that also serves as a walkway. This horizontal beam is divided into 20-ft. spans along the side of each basin and into two 27-ft. spans at the end by tie beams. Facilities for washing the basin include a 4-in. water line suspended along the west wall 5 ft. above the floor, with those valves installed for connection with standard fire hose.

The head house and filter room is conveniently located adjacent to the Philadelphia & Reading Railroad, so that a short spur track in combination with a large unloading platform allows chemical and chlorine deliveries to be made directly from the freight cars.

There are six rapid sand filters, each having a surface area of 608 sq.ft. to filter 1¾ m.g.d. at the usual rate of 2 g.p.m. per square foot. Filter sand with a thickness of 30 in. is used. The specifications called for an effective size between 0.35 and 0.45 mm. and a uniformity coefficient not greater than 1.65. The sand is supported on 18¾ in. of gravel graded in seven hand-placed layers.

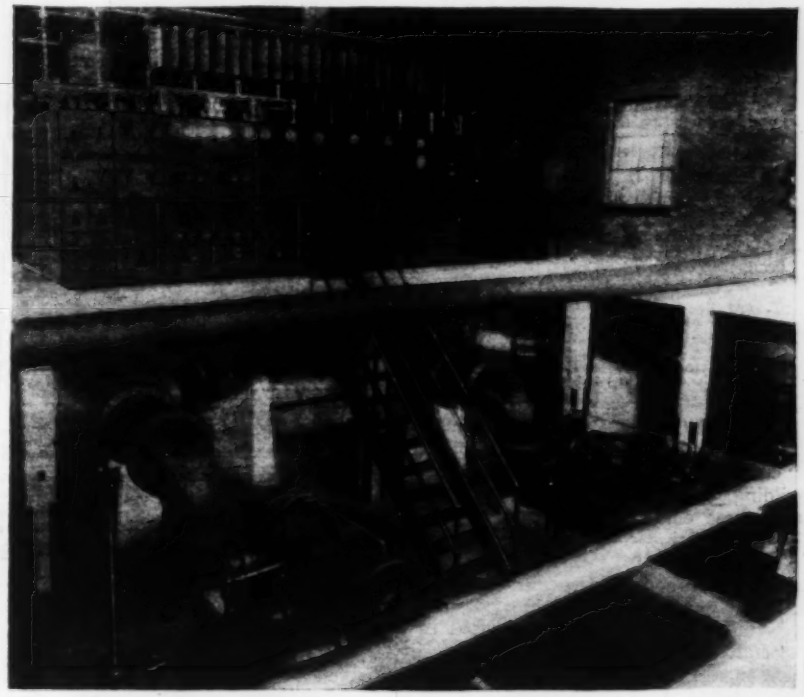
The rate of wash is 26 in., vertical rise per minute giving an expansion of the sand of about 50 per cent. The sand has remained clean.

A somewhat unusual non-pressure underdrain system is used in this plant. It consists of 6-in. diameter half-round cast-iron pipe spaced 12 in. apart and supported ½ in. above the filter floor with iron spacer blocks. Along the top of each pipe are drilled 1-in. diameter holes spaced on 6-in. centers.

Filtered water flowing to the suction chamber of the high-lift pumps is chlorinated. Two standard chlorinators have been installed in the chlorine room and are of the solution-feed type. Each machine has a range in capacity for treating from 5 to 20 m.g.d. Ordinarily about 0.3 p.p.m. of chlorine is required.

A steel washwater tank on a tower with a capacity of 100,000 gal. is used for washing the filters. Specifications called for a height of 36 ft. above the foundations and a drawdown in the tank of about 23 ft. Filtered water is delivered to this tank by two 350-g.p.m. pumps located in the high-lift pumping station. Water for washing, which has averaged only 1.6 per cent, is measured by a 24-in. venturi meter.

The high-lift pumping station houses the three high-lift pumps, having capacities of 7,000, 5,600 and 4,200 g.p.m. Each pump unit consists of two single-stage pumps in series, of the horizontal



Switchboard and three units of 7,000-, 5,600- and 4,200-g.p.m. capacity, respectively, in the high-lift pumping station. Units are designed to operate against 250-ft. head.

split-case type, designed to operate against a head of 250 ft. All pumps operate at constant speed with a direct connection to standard synchronous motors. These motors are of 600, 500 and 325 hp., respectively. A vacuum system has been provided for priming. The suction chamber under the center of the building extends the full length of the structure so that a future pumping unit can be installed. At the side of this chamber is a drainage well with a capacity of 50,000 gal. Piping arrangements are made so that filters can be washed into this drainage well when the river level, due to floodflow, is above the elevation of the main filter drain. To avoid possible contamination of the filtered water, a double wall with an asphalt membrane in the center separates the suction chamber to the pumps from the drainage well. Two vertical centrifugal sump pumps with 10-hp. motors are installed for draining this basin, each pump having a capacity of 1,000 g.p.m.

The high-duty pumps discharge through a cast-iron header line into the 48-in. cement-lined cast-iron supply pipe, which carries the water to the various distribution systems. A venturi meter, located just outside the high-lift pumping station, meters the flow of water from the plant.

Construction—All concrete for the filters, coagulation basins and high-lift pumping station was made and poured by a 1-yd. gasoline-driven mixer discharging the concrete through chutes from a steel tower 165 ft. high. A 145-ft. tower was used for pouring the subsidence basin. Cement, sand and aggregates were delivered to the mixing plant by a short trestle extension to the main track along the north side of the filter building.

Personnel

The preliminary plans and final designs were prepared by Nicholas S. Hill, Jr., consulting engineer, New York City. The general contract was held by the Amburgen Construction Co., of New York City. Construction work was conducted by its subsidiary company, the Raritan Construction Corp. The Elizabethtown Water Co. was represented by R. R. Stone, engineer, and J. L. Radcliffe, chief chemist. George H. Buck was resident engineer, representing the consulting engineer. W. W. Grotta was construction engineer for the Raritan Corp., and H. A. Grassmann was in general charge of all construction.

Road Equipment Invention Shows Large Dividends

A ten-year review of roadbuilding machines and prices in Pennsylvania reveals how paved-road quality has been raised, production increased and cost lowered as construction equipment has been progressively improved

THE DEVELOPMENT of equipment for paved-road construction has had two controlling objectives—to save labor and to improve quality. The saving of labor by the use of equipment comes: (1) from reduction in the number of men employed in any operation; and (2) from reduction in the number of labor hours necessary to complete an operation even though the number of men employed may not be decreased. The gain to the contractor is increased production and decreased time to accomplish a definite task. The highway engineer gains if the gains to the contractor are reflected in lower prices bid and the quality of the work is not decreased. The following article gives the factual experience of a state notable for its extensive construction of paved roads, in equipment improvement, price reduction and quality of product. It is based on studies of the ten-year period 1921-1931, conducted by C. H. Backlus, construction engineer, Pennsylvania department of highways, and reviewed by P. M. Tebbs, assistant chief engineer, for the Association of State Highway Officials of the North Atlantic States. —EDITOR.

IN A DECADE Pennsylvania, with other states, has benefited by great change and improvement in roadbuilding equipment. Of what nature have these changes been? What have they given in reduced costs, better quality or increased outputs? Answers to these questions have been sought by a survey of ten years of state roadbuilding records. They are summarized in the statements and tabulations below.

Grading

By 1921, ½- to ¾-cu.yd. steam shovels had become standard equipment for rough grading in Pennsylvania, although that year and for a few years following the contractors continued to use tractors, plows, scoops and road machines where grading quantities were comparatively small. At this stage of development, wagons were used almost exclusively to haul the excavated material from the cut or borrowpit to the embankment, where it was spread by hand labor with shovels or light road machines and rolled with 10-ton steam rollers.

Development was rapid. Steam shovels were superseded by gas, gas-air or gas-electric shovels, and the sizes were increased to 1, 1¼ or 1½ cu.yd. Team and wagon hauling gave way to trucks, or to tractor haulage of large wagons. The requirements for spreading larger volumes developed, larger tractor-hauled road machines, and they were succeeded by the now almost universal tractor-propelled bulldozer, which can operate without any labor on the embankment, except a foreman to direct where the material is to be dumped. The steam roller has become obsolete and has been succeeded by the faster and stronger gasoline roller.

In 1921 in Pennsylvania, if a shovel averaged 200 cu.yd. of material removed and placed properly in the embankment, it was considered a good day's work. Today, if the production is not many times that figure, a detailed investigation is made by the contractor.

Both the quantity and quality of the grading have been increased, and Table I shows a very material decrease in the unit prices bid. An interesting fact to be noticed is that in 1924, the first year in which a separate unit price was asked for subgrade and shoulders, the change increased by $0.466 a cubic yard the unit price for excavation. A slight reduction was apparent in 1925, but it was not until 1926, when the revised unit price (including subgrade and shoulders) was $1.214, that the department was credited properly by contractors for the change in specifications.

The decrease of more than 30 per cent in the unit price of the year 1931 as compared with 1930 is attributed to the comparatively small program in Pennsylvania for that year, with the resultant keen competition and the fall in prices due to the depression. The reduction of grading quantities per mile was due to improving roads of lesser importance where refinements of alignment and grade were not as necessary. This reduction in quantities apparently did not effect a reduction in unit costs.

Subgrading

In the early days of highway construction in Pennsylvania all fine or subgrading was performed by teams, plows and hand labor. The roller, equipped with scarifier, and the road machine followed. These were followed by subgrading machines pulled by the roller and by one-man power graders. This resulted not so much in a reduction of men employed as in a vast increase in the amount of subgrade that could be prepared in a given time. It was with the advent of improved subgrade equipment that pavement production was increased materially for the first time, but it was not for several years afterwards that contractors were capable of keeping subgrading sufficiently in advance of paving to insure continuous operation of the paving equipment. The unit prices for this class of work, 1924-1931, are given in Table II.

These prices disclose no real saving to the state due to improved equipment and methods; the saving of 25 per cent in 1931 is on account of existing economic conditions. This lack of saving may be attributed to higher standards and stricter adherence to them. Changes in form sizes and designs at that time account for the higher prices of 1924 and 1925.

Form-setting

Form-setting is a part of the subgrade operation and costs, and it is so included in the bid price for subgrade; but it is such an important item, from a labor-saving standpoint, that it is treated separately. Early forms were designed merely to establish the limits of the concrete pavement, with no real purpose of resisting the impact of the pavement-fabricating operations. The advent of finishing machines brought out the necessity for stronger forms to insure smoother-riding pavements. This stronger form results in a large saving in labor by eliminating the checking and resetting that had become necessary when lighter and weaker forms had been used. Pennsylvania will hereafter specify a minimum base width of 8 in., and it is felt that this will effect a still greater saving. The use of form graders has proved efficient in many cases and resulted in large savings.

TABLE II — SUMMARY OF COSTS OF SUBGRADING FOR THE YEARS 1924 TO 1931

Year	Bid Price per Sq.Yd.	Cost per Mile of 18-Ft. Road
1924	$0.154	$1,626.24
1925	0.160	1,689.60
1926	0.141	1,488.96
1927	0.135	1,425.60
1928	0.130	1,372.80
1929	0.139	1,467.84
1930	0.143	1,510.08
1931	0.109	1,151.04

TABLE I — SUMMARY OF GRADING COSTS FOR YEARS 1921 TO 1931, INCLUSIVE

Year	Cu.Yd. Cost of Excavation Class 1	Class 2	Borrow	Unit Prices Clearing-Grubbing Per Mile	Subgrade, Sq.Yd.	Shoulders, Lin.Ft.	Average Number Cu.Yd. Per Mile	Average Mile Cost
1921	$1.805	.....	$1.805	.....	.....	.....	5,820	$10,500.00
1922	1.192	.....	1.192	.....	.....	.....	5,890	7,020.00
1923	1.433	.....	1.571	.....	.....	.....	4,523	6,900.36
1924	1.377	.....	1.304	.....	.154	.208	5,848	10,599.00
1925	1.166	.....	1.026	.....	.160	.198	7,445	10,959.67
1926	.883	$1.345	.881	.....	.141	.179	9,459	10,355.62
1927	.941	1.626	.858	.....	.135	.178	9,408	11,051.96
1928	.792	1.608	.790	$319.30	.130	.172	12,595	12,486.15
1929	.810	1.670	.766	460.14	.139	.196	16,432	16,470.66
1930	.775	1.777	.731	577.75	.143	.195	19,412	18,579.85
1931	.535	1.340	.483	299.05	.109	.167	9,462	7,603.98

Forms and the equipment and methods used to set them have resulted in a marked increase in the quality of the finished product, even if there has been no apparent saving in actual cost of the work.

Slab concreting

It is in the pavement itself that there have been the greatest changes in the types of equipment employed and the methods of operation.

Until 1921 Pennsylvania permitted aggregates to be stored in small piles upon the subgrade and the mixer skip to be charged with wheelbarrows. In 1921 batch hauling in trucks and by industrial railway made its first appearance. This revolutionized completely the equipment for unloading, handling and hauling materials; and instead of decreasing production and increasing costs, as at first claimed, it actually accomplished the reverse and also increased immeasurably the quality of the pavement. It was the first year that concrete pavers in Pennsylvania began to complete more than a mile a month. The first batch trucks were maximum-weight equipment with solid tires and they were favored for several years. It actually required specification changes to educate the majority of contractors to the numerous advantages of the lighter type—two or three-batch pneumatic-tired trucks.

Improvements in the types and designs of proportioning plants, toward ease of setting up, speed of operation, automatic control and minimum of effort required to operate, have improved the quality of the finished product. This is especially true of the weight control of aggregate now in universal practice.

Another of the primitive methods was storing cement on the subgrade and dumping it direct into the skip of the mixer. This required an additional handling and rendered it almost impossible to secure the required proportion of cement in each batch. This was followed by placing the cement in bags on top of the aggregate and dumping it on each batch at the mixer before charging the skip. A still further reduction in handling was made by designing separate weatherproof cement boxes on the trucks, which were loaded at the proportioning plant and dumped with the aggregate into the skip. This led toward bulk cement, the use of which is now becoming popular and economical. Unloading and weighing plants for bulk cement are many and varied—from the high-priced plants, in which the only labor employed is the men who weigh the material, to plants in which the cement is loaded, hauled, weighed and dumped by hand labor into the truck compartments. All these plants save in labor costs as compared with handling cement in bags.

Prior to 1924 wire mesh was used exclusively for reinforcing concrete pavements. In 1923 a sled device was introduced for supporting the mesh in proper position in order that the concrete could be poured for the full depth through the mesh and not retard progress by pouring it in two courses and placing the mesh between these courses. Its use was prohibited because of voids left in the concrete as the sled was moved ahead. The sled also made it difficult to check the subgrade.

A device for holding the mesh in proper position, supported from bars placed above the pavement between forms, was premitted, but instead of resulting in a saving of labor it required practically the same number of men to install the equipment and delayed the placing of concrete until the entire mixing pit had been cleared and checked. This same delay occurred when marginal-bar reinforcement was in common use from 1924 to 1927 inclusive.

Mechanical strike-off devised

To overcome delays in placing wire-mesh or bar-mat reinforcement in the proper position and to eliminate the hard hand labor in leveling the first course of concrete, one Pennsylvania contractor developed in 1929 the mechanical strike-off templet. This consisted of an ordinary wooden templet that operated on the forms. When the concrete was spread the full length of the pit, it was struck off by the templet, the power for pulling it toward the mixer being a power take-off utilizing the drum on the mixer that had been provided for unloading batch boxes from the industrial railway. Two cables operated from the drum, with the ends attached to the templet sides.

This method proved to be so effective that mechanical striking off was made mandatory in the 1930 specifications. The templets are now being manufactured by several companies. In 1930 practically all contractors adopted this new device, and on especially efficient jobs it reduced the pit crew to three men and spread the bottom course with little or no hand spreading except against the forms. In 1931 the templet was redesigned to provide greater clearance between templet and bucket, which resulted in still more efficient operation.

An effort was made by finishing-machine manufacturers to place an extension to the screed to strike off the concrete. This method was not practicable or economical, as it was necessary for the machine to be at a certain definite fixed point at an equally definite time, which resulted in neglect of the finishing or in delaying the strike-off operation and placing of reinforcement.

The first finishing machines of the tamper type eliminated the hardest and most tedious of the hand-labor operations and dispensed with at least two laborers. This type was succeeded by the screed or combination screed and tamper types. In addition to the direct-labor saving, progress was increased and pavements were improved by the use of much drier concrete. The first machines produced a pavement rougher than the hand-finished product, but improved mechanism and more experienced operators have corrected this condition; the machine-finished pavement of today has the best riding surface that has ever been constructed.

Experiments have been under way for two years to provide a mechanical means of applying bituminous material and mineral cover to cleft center joints at the time they are opened and finished. This will reduce the working force by at least one man.

Curing of concrete with the 2-in. covering of wet earth or straw has been superseded by the admixture of calcium chloride. At first there was no apparent reduction in cost to the contractor, as the material was mixed by hand and placed in the drum by hand labor. The modern concrete paver now mixes the solution automatically, and a positive automatic device adds this solution in the drum of the mixer. One or two men have been eliminated, and positive curing is being secured with a minimum of human effort. Where the wet-cover method of curing is still practiced, mechanical devices have supplanted the man or boy with the hose.

The design of concrete pavers has progressed consistently toward larger and faster machines, with special emphasis placed upon speed of loading and discharging, including automatic features. There have been requests for larger machines. The manufacturers feel that failure of the user to secure maximum production from the present equipment does not warrant the cost of designing, testing and manufacturing a larger mobile unit than the 27E paver.

Ready-mixed concrete

The use of ready-mixed and transit-mixed concrete has grown in the past few years, and, under rigid specifications and not too long a haul, it has proved successful in reducing fabricating costs and providing a satisfactory pavement.

The development of a belt conveyor for transferring concrete from the truck to the subgrade, while not a direct labor saver as far as this particular operation is concerned, prevents rutting of the subgrade by the truck, which operates outside the forms. Time is also saved in backing the truck into the proper position. One of the great advantages is the ability to keep the work going in event of breakdowns. As a general rule, not more than one truck at a time should require repairs, while if a concrete paver is broken down, the job must be suspended until repairs are made. The initial cost of equipment for transit-mixed and ready-mixed concrete must be balanced against any increased production that is possible.

Tandem mixers have been used in several Western states. The reports on

increased production appear to be fairly satisfactory, but the data are rather meager on costs of construction and quality of product.

A summary of average unit costs of reinforced-concrete pavement for 1921 to 1931 inclusive is given in Table III. These figures show a considerable reduction in 1922 prices as compared with 1921. In 1923, 1924 and 1925 changes in design tended to increase prices, which increases were not otherwise justified. The year 1926 showed a considerable reduction. From this year to 1930 inclusive a fairly uniform price level was maintained. The general trend from 1921 to 1930 inclusive was toward lower prices. In 1931 there was a reduction of one-third below the 1929 levels. This can be explained in part

TABLE III — SUMMARY OF COSTS OF CONCRETE PAVING FOR THE YEARS 1921 TO 1931

Year	Type	Unit Costs — Per Square Yard	Unit Costs — Per Cubic Yard
1921	5–7–5	$3.530	$20.070
1921	6–8–6	3.840	18.850
1922	5–7–5	2.830	16.090
1922	6–8–6	3.000	14.730
1923	6" uniform	3.450	20.700
1923	7" uniform	3.460	17.800
1923	9–6–6–9	3.550	18.260
1924	8–5–5–8	3.262	19.177
1924	9–6–6–9	3.538	18.200
1925	8–6–8	3.374	18.218
1925	7½–5½–7½	3.215	18.757
1925	7–5–7	3.086	19.594
1926	7½–5½–7½	2.847	16.610
1926	8–6–8	3.038	16.404
1927	8–6–8	2.701	14.580
1927	9–7–9	2.987	14.020
1928	8–6–8	2.796	15.100
1928	9–7–9	2.886	13.550
1929	8–6–8	2.736	14.770
1929	9–7–9	2.906	13.640
1930	8–6–8	2.790	15.060
1930	9–7–9	2.943	13.820
1931	8–6–8	1.948	10.520
1931	9–7–8	2.064	9.690

TABLE IV — SUMMARY OF SHOULDER-CONSTRUCTION COSTS FOR THE YEARS 1924 TO 1931

Year	Bid Price per Linear Foot	Approximate Cost per Mile of Road
1924	$0.208	$1,098.24
1925	0.198	1,045.44
1926	0.179	945.12
1927	0.178	939.84
1928	0.172	908.16
1929	0.196	1,034.88
1930	0.195	1,030.60
1931	0.167	881.76

by the depression, but it is also due to a very considerable extent to the studies and recommendations made by the department in 1929 and 1930 and made available to all of the contractors of Pennsylvania. These studies revealed that no equipment or method can be more efficient than its operators.

Shoulder construction

Improved models of road machines, with back-slopers and one-man power graders with pneumatic tires, have been the principal developments in labor-saving machinery for shoulder construction. Progress and quality of work have been improved considerably, but as shown by Table IV there has been no appreciable price reduction from 1924 to 1930 inclusive. Reduced costs in 1931 are attributed to existing economic conditions.

Civil Engineers Approve Public Works Program

A plan to stimulate trade revival through state, county and municipal public works financed through extension of federal credit is approved by Am.Soc.C.E. executive committee

IN VIEW OF the increasing seriousness of the present economic situation a group of the members of the American Society of Civil Engineers recently urged upon the board of direction that the society depart from its custom of concerning itself only with scientific and professional matters, and that it lend support to a movement to end the present depression. As a result the outline of a plan, together with a preamble pointing out how the plan is expected to help correct the existing economic situation, was presented to the board on May 9, together with a petition that the board, should it approve that plan, appoint a committee to represent the society before Congressional Committees. The petition was signed by V. T. Boughton, W. T. Chevalier, George W. Fuller, John P. Hogan, George L. Lucas, R. C. Marshall, Jr., H. deB. Parsons, J. P. H. Perry, Malcolm Pirnie, James F. Sanborn and F. E. Schmitt.

On May 9 the executive committee of the board by formal resolution, gave its approval to the plan and subsequently provided for the appointment of the committee asked for in the petition. It also provided for presentation of the subject to American Engineering Council and to the local sections of the society. The executive committee's resolution was published in the news pages of last week's issue. The statement concerning the plan for economic revival through public works construction is given substantially in full in the following.

Business recovery

The chief essential of business recovery is the general resumption of trade. This implies the restoration of the consumer's will and capacity to buy, the result of which will be renewed buying by middlemen and manufacturers also. At present all buying has been curtailed by: (1) loss of employment and reduced incomes, (2) fear and uncertainty as to the future, (3) declining commodity prices.

The remedies thus far applied by the federal government have been directed to: (1) greater security of financial institutions, (2) restoration of general confidence, (3) abatement of hoarding. The immediate objectives of these efforts have been realized to an appreciable degree. General buying, however, still is backward. The ultimate and essential objective, therefore, has not yet been attained. Dealers, both wholesale and retail, cannot be expected to replenish their stocks in the face of curtailed demand and falling prices; manufacturers and service utilities cannot be expected to speed up production or expand their production facilities in the face of excess capacity and depleted earnings. Trade languishes on a hand-to-mouth basis. Everyone has been caught in a vicious spiral of falling demand, declining output, increasing unemployment and diminishing consumer buying power. The improvement of financial security and general confidence has not as yet sufficed to overcome the momentum of the decline.

The immediate need

The immediate and urgent need, therefore, is somehow to prime the pump that maintains the flow of trade, to inject somewhere in the cycle an impulse that will check the decline and reverse its downward trend. The most direct remedy is to create a net consuming power that will make itself felt from the counters of dealers back to the shops of the manufacturers developing increasing volume as it flows and breeding renewed confidence, which will become the basis of an even greater volume as the reversal of trend becomes evident and as commodity prices begin to rise.

A certain amount of such consuming power has been generated by intelligent and aggressive merchandising policies in some branches of private enterprise. But large-scale recovery resulting from this process alone must be very slow, faltering and spotty. *The net effect* of the buying power that is created by increased employment in private industry is much smaller than might be assumed from the increase in wages and salaries paid because of the inevitable increase in the volume of goods that are produced and must be absorbed by the consumer.

If it is possible to create a large consuming power without this proportionate increase in the current volume of goods to be bought, the necessary stimulus to trade can be applied more directly, more swiftly and with vastly increased net effect. The more swiftly and more heavily it can come into operation the sooner will private enter-

prise feel its quickening influence and generate within itself the power to carry on the improvement.

Measures to stimulate buying

Several measures have been suggested whereby there may be applied such an impetus to consumer buying, but most of them are open to the serious objection that they are purely agencies of inflation, helpful if scrupulously controlled, but dangerously likely to get out of hand and make matters worse.

One recourse is available, however, that offers the brightest promise of an immediate stimulation of consuming power without a counterbalancing production of goods for current consumption. It would avoid the demoralization of a dole, conserve the wealth represented by the funds released and avert the peril of excessive inflation. These requisites all can be met by a nation-wide program of public works construction—federal, state, county and municipal—the state, county and municipal works to be financed by bond issues reinforced for the period of the emergency by the credit of the federal government in order to insure reasonable interest rates.

An expansion of public works construction is particularly necessary and appropriate just at this time because of the substantial decline in construction volume that has already taken place and that is in sight for the immediate future. In 1926 the total volume of construction, both public and private, was nearly $9,000,000,000. Disregarding the peak developed during 1927, 1928 and 1929, this volume in 1930 was less than $8,000,000,000, and in 1931 it had fallen to $6,000,000,000. Estimates for 1932, based upon the record to date and the present outlook, aggregate less than $3,000,000,000 of construction work, or only half that of last year and appreciably less than that of 1919 and 1920.

It is noteworthy that for the past six years the volume of public works construction alone has remained reasonably constant at about $3,000,000,000, despite the peak in private work, indicating that this figure represents the normal and reasonable requirement for community facilities.

Slight hope remains for any considerable volume of private and industrial construction during 1932. Public work, therefore, constitutes the only reliance for construction activity, and present estimates indicate that this will amount to scarcely more than $1,500,000,000, or about half the normal. Surveys made by the President's organization on unemployment relief indicate that the amount of necessary and worthy projects *abandoned* during the past twelve months would be enough to restore the program to normal functioning.

A public works construction program offers several advantages that deserve serious consideration.

1. The funds expended to pay for such works add directly to the buying power of the community without a counterbalancing production of goods that must be bought out of current income.
2. Public works add to the public wealth in the form of community facilities and thereby conserve the wealth represented by the funds thus released.
3. Such a program starts a train of increased employment that reaches back through many industries in many communities, thereby stimulating activity of private industry.
4. It uses existing public works organizations, thereby saving valuable time in getting under way, while avoiding widespread additional unemployment now threatened by the further suspension of public works and restoring to useful and productive work many now unemployed.

It may be urged against such a program that eventually the taxpayer must pay, in the form of interest and sinking-fund charges, for the facilities thus provided. That is true, but meanwhile the impetus to buying will have made itself so felt in trade that the taxes, when due, will bear less heavily upon restored incomes. Furthermore, such taxes represent an investment in community facilities; they do not involve the sheer waste and demoralization of a dole.

Public works vs. direct relief

Taxes to pay doles or direct relief under any other name contribute little to the stimulation of trade and are far more burdensome to the taxpayer, especially as they must be raised at a time when he is least able to pay them.

To illustrate the economy of unemployment relief by stimulating trade rather than by taxation to pay a dole, assume a public works construction program amounting to $3,000,000,000. This involves a charge for interest and amortization of about $150,000,000 per year. It is estimated that such a program would give employment to between 1,500,000 and 2,000,000 workers per year, distributed through the several industries that serve construction and are widely scattered over the country. To support these same workers in idleness would cost the community between $750,000,000 and $1,000,000,000 per year. This sum must be raised through taxation or bond issues. But the money so raised would be wasted, the moral effect of a premium on idleness would be unfortunate, little if any stimulus would be given to normal trade, and the current burden upon the depleted earning power of the community would be greatly multiplied. If the community is to shoulder the burden of maintaining its less fortunate members, is it not wiser and more reasonable to utilize their productive capacity in adding to the community wealth and thereby stimulate the normal processes of trade upon which must depend the restoration of community prosperity?

Taxes and budgets

So much emphasis has recently been laid upon the subject of taxes that the public is prone to lose its sense of proportion. It forgets that any additional taxes required to finance a program such as here proposed will be negligible as compared with the shrinkage of values and loss of earnings that prevail under present conditions. They will be equally negligible when paid out of the earnings of a revived trade and industry.

It may be urged that such a program is contrary to the present demand for a general balancing of governmental budgets. But it must be remembered that the balancing of budgets on paper is one matter; actual balancing is quite another. That must depend upon the collection of the estimated revenues, which, in turn, must depend upon maintaining the earnings of the community, the ultimate source of all taxes. Budgets cannot be balanced *in fact* by methods that strike down the earning power of those who must provide the revenues.

Furthermore, the balancing of budget so far as *current operations* are concerned is desirable; but it is not necessary to include in such balancing the principal sums invested in useful public works. Competent economic opinion has almost universally held that it is wise governmental finance to borrow for this purpose in periods of depression and to repay out of taxes levied upon the surplus earnings of prosperity. Public works built at present wage and price levels and financed at reasonable rates of interest will carry a very low cost and require a relatively lower debt-service charge in the tax rate over years to come. *It is good business as well as good tactics to use this opportunity to add substantially to the public wealth.*

State and municipal programs essential

Federal public works alone, however expanded, cannot possibly meet the requirements of the situation. The major effort must be exerted through the state, county and municipal programs, which normally provide the bulk of our public works construction. But it is the municipalities and some of the states which have found great difficulty during recent months in raising sufficient funds at reasonable interest rates to finance their 1932 programs; and this is despite an urgent need for many such works, for which plans are already

prepared and construction organizations are in existence.

It is proposed, therefore, that the federal government maintain the largest feasible federal public works program and that it reinforce the credit of states, counties and municipalities sufficiently to enable them to carry out their necessary public works programs through their own bond issues.

Proposed legislation

In attempting to formulate specific legislation to this end it is necessary to keep in mind not only the objective sought but also the administrative and political difficulties involved. These arise from the constant changes in the economic and financial situation and outlook.

The following proposals for legislation can only establish a basis upon which may be developed any alternative measure that may meet the essential requirements and may be in accord with the current public attitude toward economic legislation.

The legislation necessary to effect the purpose proposed could be based upon that which has already found successful application in the Reconstruction Finance Corp., i.e., the credit of the federal government could be extended to *reinforce* the securities of states, counties and municipalities that may be issued to finance necessary and useful public works. It is possible that this function might be assigned directly to the Reconstruction Finance Corp. or to some affiliated agency. If this is not feasible, an independent but analogous agency should be set up for this purpose.

It is true that when the Reconstruction Finance Corp. was established such a policy was rejected, but since that time the corporation has demonstrated its capacity to function successfully, conditions and needs have changed, and it may now be in order to extend its operations beyond the scope to which it was then thought wise to limit them.

Moreover, it has become evident that the most promising sphere in which to seek an early and effective expansion of trade is that of public works construction. If federal credit is to be invoked for the purpose of stimulating trade, the time has come, therefore, to apply it where it has the most promising opportunity to accomplish the largest measure of results in the shortest time.

No present recommendation is made as to the floating of a federal bond issue, but the possibility of such a measure must be kept constantly in mind as a preferable alternative to federal borrowing for a dole or for any other form of direct relief. If the government must borrow to effect economic relief, it will be far better to invest the funds so raised in the community facilities, thereby conserving the public wealth and stimulating a normal resumption of trade than to disperse them in wasteful, inflationary or demoralizing expenditure.

In operation, a federal credit corporation as here proposed would examine and pass on state, county and municipal projects for which money cannot now be raised. If these projects were found to be economically sound, properly planned and administered, it would purchase the necessary bonds or other approved obligations of the states or municipalities at reasonable interest rates and would hold them until such time as they could be sold in the public market without loss. The federal government thus would be eventually reimbursed, the cost of improvements assessed on the beneficiaries, and supervision would be provided to curb wasteful expenditure.

It is indeed possible that no large amount of capital would be permanently employed. The guarantee of this finance corporation that the works were justified and sound and that the municipality or state was in good financial condition would be sufficient to make the securities marketable after a short period. It is possible also that the difference between the interest rates charged to the borrowers and those that would be paid on the obligations of the corporation would be sufficient to defray the expense of administration, and that the net ultimate cost of the whole operation to the federal government would be nil.

An analysis of the reports of the public works section, President's organization on unemployment relief, shows that $1,963,000,000 worth of state, county and municipal construction contemplated for 1931 has n gone forward, and reports of n projects for 1932 indicate that the to of these for the year approach $1,000,000,000. Combining these t figures, it would appear that the nece sary public works that are ready to g forward during 1932 amount to at lea $3,000,000,000.

Conclusion

Steps should be taken at once, therefore, to embody a program of public works construction in appropriate legislation, either as an amendment t existing law, as a new bill, or as a provision of some appropriate bill now under the consideration of Congress. There is urgent need for the trade stimulus that can be realized through a public works program, soundly planned and adequately safeguarded as here proposed. The guarantee of federal credit has been a healthy influence in restoring the security and stability of the financial structure; now is the opportunity to apply it to the actual stimulation of business recovery.

Committee appointed

Following the publication of the statement given above, Herbert S. Crocker, president of the American Society of Civil Engineers, announced the appointment of a committee to represent the society in the advancement of the program outlined therein. The committee consists of John P. Hogan, consulting engineer, New York, chairman; Harrison P. Eddy, Boston; A. J. Hammond, Chicago; Joseph Jacobs, Seattle, Wash.; and Malcolm Pirnie, New York.

Fire-Protection Men Discuss Codes, Hazards and Materials

New regulations and revisions of existing ones considered at meeting of the National Fire Protection Association—Fireproofed wood of much current interest

Engineering News-Record Staff Report

SUBJECTS of interest to a variety of engineers and to architects were discussed at the 36th annual convention of the National Fire Protection Association held in Atlantic City, May 9-12. Those of special importance to the readers of this journal related to the association's codes for various types of buildings, to construction hazards and building materials.

Fireproofed wood

One of the most interesting reports submitted to the convention was that of the advisory committee on fireproofed wood (chairman, Dana Pierce, president Underwriters Laboratories, Chicago). This committee was appointed at the January meeting of the board of directors to report on the present status of the art and to consider what action the association should take in regard to the fireproofing of wood.

The committee pointed out the unsatisfactory condition that exists as to dependable information on methods of fireproofing wood and the results to be obtained through its use for building

construction to reduce fire hazards, also as to specifications for treating wood to minimize its combustibility. Committee C-5 of the American Society for Testing Materials has been working on this latter subject for some time and is now drawing up standards, but the work is making slow progress.

The committee noted that the last few years have seen increasing interest in the use of such material. The New York City building code requires that wood for trim and wood for other specific purposes be "fireproofed" in buildings more than 150 ft. high and a few lumber companies are promoting its sale. Wood-preserving companies see in the fireproofing of wood a new outlet for their products, and so they are becoming interested. Because of this new interest the committee sees special need for definite specifications. In such specifications distinction must, according to the committee, be made between the purposes for which the wood is used—whether the need is simply to reduce its combustibility (as contributing to a conflagration) or to use it as a fire retardant and heat-insulating material (as in the case of doors and sheathing); also whether the material is to be thoroughly impregnated or simply surface-treated. Methods of testing and inspecting fireproofed lumber also are needed, as are means of distinguishing it from untreated material.

Pier fires

The recent Cunard pier fire at New York drew special attention to the report of the committee on piers and wharves. Discussion centered upon whether there was creosoted timber in the pier and upon the extent to which it contributed to the spread of the fire if present. [The sub-floor and stringers were of treated timber and the piles were untreated, as reported in *ENR*, May 12, 1932, p. 707.]

Last year this committee (chairman C. H. Fisher, consulting engineer, New York) presented revised regulations for piers and wharves, which were adopted by the association. The regulations have been favorably received and have been adopted by the American Association of Port Authorities and other interested organizations.

Car houses and garages

Because of the increasing use of trolley buses the committee on electric-railway car houses and cars presented proposed regulations for wiring such buses and accompanied the report with a list of the twenty communities where such buses (a modernization of the trackless trolley) are in operation. Chicago now has well over 100.

If parking on the streets of our cities is to be reduced materially, the average city must change its regulations regarding the storage of automobiles, the committee on garages reported. Improvements in internal-combustion engines, in fuels and methods of handling them have made many of the older regulations unnecessary, according to the committee. Modernization of regulations is needed, and to that end the committee submitted as one.element requirements for the construction and maintenance of garages, which represent a safe liberalization of requirements heretofore employed. Discussion brought out the fact that the report was not intended to be a complete set of specifications for the construction of large garages but covered only matters not dealt with by general building codes.

Construction fire hazards

Recent fires in connection with construction operations were reviewed by Wm. B. White, Board of Underwriters, New York, and chairman of the committee on construction operations. The committee reviewed the conditions surrounding these fires and discussed probable causes.

A report on fundamental standards for fire-resistive building construction was presented by the committee on building construction in tentative form. When completed, these standards will be presented to the association for adoption to replace the ones prepared in 1918 by the late Ira H. Woolson. Robert S. Moulton, technical secretary of the association, pointed out that these standards of building construction prepared by the association differ from those in building codes in that the association specifications sets up the *ideal* to be attained, while buildnig codes specify the *minimum* below which it is not safe to go. Upon request of S. H. Ingberg, of the Bureau of Standards, a member of the committee, the report was referred back to the committee and will not be printed in the association's *Proceedings* this year.

Building exits were the subject of a progress report by the committee on safety to life, also presented by Mr. Moulton. This committee is working with a committee of the Department of Commerce in an effort to get the association's and department's codes relating to exits into agreement. There is wide divergence now on a few points. One is the matter of duplicate egress facilities. The association code calls for duplicate egress facilities; the department's does not in some cases, notably towers of office buildings where the floor area is relatively small and occupancy limited. Mr. Moulton was unable to get an expression of opinion on this point from the convention.

Protection of records

Data of interest to those concerned with methods of protecting records against fire, especially large quantities in safes and vaults, were presented by the committee on the protection of records. Results of fire-exposure tests for vaults and portable record containers were given for both fire-resistant and non-fire-resistant buildings, chiefly as a means of determining whether it is necessary to provide protection in safes designed for one-hour exposure to fire or in six-hour vaults. Data on the design of vault doors, submitted by the committee to bring existing requirements up to date, were tentatively adopted.

Dust explosions

Completely revised regulations for the prevention of dust explosions in flour and feed mills were submitted by the committee on dust-explosion hazards. These regulations contain a section outlining the desirable structural features for such mills.

Charges for sprinkler supplies

There is no justification for a readiness-to-serve charge to companies maintaining automatic sprinkler systems, according to the committee on public water supplies for private protection. Waterworks systems must have adequate capacity for protecting the entire community. Every taxpayer contributes his proportional share of the cost of providing that service through general tax levies; hence the one who reduces the community fire hazard by extending that service into his plant should not be made to pay twice for it. He should bear no charge or at most not more than interest on the actual cost to the waterworks to make the connection, plus an inspection charge.

Recommended requirements for the installation, maintenance and use of piping and fittings for city gas were submitted by the committee on gases, and were adopted. They relate chiefly to gas services in buildings and not to mains in streets.

New officers

The new officers elected for the year 1932 were: President, Sumner Rhoades, Eastern Underwriters Association, New York; vice-presidents, Harold L. Miner, manager of the safety and fire-protection division, E. I. du Pont de Nemours & Co., Wilmington, Del., and George W. Elliott, general secretary of the Philadelphia Chamber of Commerce. The total registration was 330.

British Transit Company Builds Garages for Commuters

In an effort to secure new patronage and to satisfy old customers better, an interurban transportation company operating into London, England, has constructed units of private garages at various stations to be used by patrons who wish to park their cars in a safe place while they are in London. Each customer carries the key to his individual garage and is in a position to take advantage of this parking privilege either day or night. The charge for the use of these garages has not been set.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Cement Hardening and Corrosion

REVIEWED BY P. H. BATES
Bureau of Standards, Washington, D. C.

ERHÄRTUNG UND KORROSION DER ZEMENTE: Neue physikalisch-chemische Untersuchungen über das Abbinde-, Erhärtungs- and Korrosionsproblem—Von Dr. Karl E. Dorsch, Privatdozent für chemische Technologie an der Technischen Hochschule zu Karlsruhe in Baden. Berlin: Julius Springer. Paper; 7x10 in.; pp. 120; 76 line cuts and halftones. 13.5 marks.

DR. DORSCH'S monograph on hardening and corrosion of cement should be of interest to the American investigator of cements (and our usage of this word carries with it a tacit understanding of its being preceded by portland) through its exposition of the rather generally accepted foreign viewpoints. It should also appeal to the American engineer using cement through its clear indication that "cement" includes portland of high early strength and usual strength type, hochofen (70 per cent slag and 30 per cent portland), Eisen portland (30 slag and 70 portland), high alumina or fused cement, Erzzement or iron oxide, portland jura cement or portland cement plus puzzuolanic silica, etc.

The little volume is about equally divided between a discussion of hardening and of the corrosion or attack of cement through salt action. The latter part is possibly not of much interest to the American reader. The conclusions based upon the attack by the solution on 3-cm. cube specimens or tensile briquets of mortars of the several types of cements would hardly be considered as good evidence of field results. To those who are engaged in evaluating aggregates and cement products by the use of sodium sulphate solutions and to those who for various reasons have turned to the use of magnesium sulphate, it may be interesting to know that the author has found ammonium sulphate to be far more effective than either of these two salts.

The part dealing with hardening covers chapters on hydration, the viscosity and electrical conductivity of cement during setting, the temperature obtained during hardening, the determination of the combined water, and the solubility in water.

Aside from such discussions as the novel ones on true viscosity (not plasticity or workability, so much discussed on this side) and electrical conductivity, the outstanding features of the monograph are the adoption of the LaFuma concept that the tricalcium silicate in portland cement hydrates to a tetracalcium aluminate and the aluminates of high alumina cement to dicalcium aluminate, and, further, that the crystallization of hydrated products plays but a small part in the hardening of cement when compared with the formation of the gelatinous ones.

On the whole, the little volume is very interesting and should prove so to those engaged in cement research. The photomicrographs are unusually good and the direct style of the author enables him to put much information in the space he has covered.

Russia as Seen by an Engineer

WORKING FOR THE SOVIETS: An American Engineer in Russia—By Walter Arnold Rukeyser. New York: Covici-Friede. Cloth; 5x8 in.; pp. 286; 32 halftones. $3.

IN POINT of general interest and of keenly critical but sympathetic comment on Soviet Russia, its five-year plan, its people, and its political system, Mr. Rukeyser's book takes high rank. It has far more breadth and depth than its title implies. It gives enough technical information about the mines and works of the asbestos trust in the Ural Mountains, 2,000 kilometers east of Moscow, to satisfy an engineer not eager for technical details. It goes far beyond this in showing how the Soviet conducts one of its major industrial enterprises. Beyond that, and of still greater interest, it pictures life in great cities of Russia, as seen by the author and his wife during their long waits for transportation; railway travel in Russia; and living conditions at Asbest both while the town was a rough and *un*ready mining camp and after some approach to an orderly industrial town had been made.

The political espionage system under which the Russian people work with fear and trembling, particularly technically and other educated men suspected of anti-Soviet interest, is graphically pictured. The author recognizes the political necessity of the GPU espionage as essential to the continued existence of Soviet rule. Dramatic point is given by a brief account of the legal trial and conviction of some Russian engineers under suspicion of working against the government and, of more intimate appeal, the arrest and incarceration of the man with whom the author and his wife were quartered on the first of their two visits to Asbest.

Another drama unfolded by Mr. Rukeyser had as its final victim the technical director of the asbestos trust. This man delayed appearance at the works, where he should have been to receive the American engineer, and later on was forced to the defensive on account of plans and methods shown by Mr. Rukeyser to be bad. Finally, the American and the Russian engineer were pitted against each other before a technical tribunal and the work of the Russian was condemned by that body. The author handles this incident with reserve and sympathy, picturing the Russian as a victim of circumstances, including the adoption of early plans made by engineers of another European nation.

As was intimated at the beginning of this notice, Mr. Rukeyser's account of his professional experience in Russia is but small part of his book and of his object in writing it. His professional experiences give realistic point to an instructive and intensely interesting picture of Russia and the Russians under Soviet rule, with emphasis upon the five-year industrial plan and the reactions of both it and other phases of Sovietism upon the people in general and engineers in particular. The book deserves high commendation in this respect, for its human interest and for its literary quality—the latter far beyond what is generally found in the few books, outside purely technical works, written by American engineers.

Home Building and Owning

PLANNING FOR RESIDENTIAL DISTRICTS: Reports of the Committees on City Planning and Zoning, Frederic A. Delano, Chairman; Subdivision Layout, Harland Bartholomew, Chairman; Utilities for Houses, Morris Knowles, Chairman; Landscape Planning and Planting, Josephine F. Morgan, Chairman. Edited by John M. Gries and James Ford, Washington, D. C.: The President's Conference on Home Building and Home Ownership, Commerce Building. Cloth; 6x9 in.; pp. 227; halftones, diagrams and tables. $1.15 postpaid; $10.50 for the projected eleven volumes.

PROPERLY, the first of the eleven volumes to be published as the outcome of the President's Conference on Home Building and Home Ownership, held last year in Washington, takes up residential districts, with special consideration of city planning and zoning, subdivisions, home utilities and, important but too often overlooked, landscaping and planting. Each of these sections was originally the work of one of the many committees that reported at the conference, since edited for this volume. Not to be overlooked is a report on "Housing in Unincorporated Areas Adjacent to Cities," prepared by a large special group of eminent authorities. Among the volumes scheduled for later

publication is one dealing with the important subject of "Home Financing and Taxation." A related volume will deal with "Home Ownership, Income and Types of Dwelling." Not all the titles have been announced, but among those that have been are "House Design, Construction and Equipment," "Negro Housing" and "Farm and Village Housing." The series promises to be a valuable one, a promise fulfilled by the one here noticed.

Engineering Cost Data

CONSTRUCTION COSTS: 1932—Fifth Annual Issue. New York: *Engineering News-Record*. Paper; 9x12 in.; pp. 99; tables, graphs, and line-cut sections of structures for which unit prices are given. $1.

AMONG the contents of this year's issue of "Construction Costs" for engineers, contractors, appraisers and estimators are costs of comparable structures built in 1913 and in 1928-31; four sets of index numbers of construction costs—*ENR*, Aberthaw, Tuttle, and American Appraisal; utility and railway costs; many comparative figures of labor wages, both by years and cities; material buying practice in twelve large cities; prices of basic construction materials in (1) various cities, for one to four years, and (2) in New York City, 1874-1931; three years' prices for waterworks materials, and many pages of unit prices on 1931 construction jobs, indexed by type and location. Many of the tables are supplemented by graphs.

Billions of Dollars

COST OF GOVERNMENT in the United States, 1929-30. New York: National Industrial Conference Board, 247 Park Ave. Cloth; 6x9 in.; pp. 167; tables and diagrams. $3.

HOW the expenditure of $13,000,000,000 in a single year was distributed among our federal, state and local governments, and by them among departments and functions, is told by text, tables and diagrams in the first 27 pp. of this annual, the ninth in the valuable series published by National Industrial Conference Board. Similar concise reviews are given for public indebtedness, tax collections, sources of tax revenue and highway finance.

Comparative figures for selected years show rapid increases in most cases. In the first section, on total expenditures of the three classes of government, actual totals for selected years are adjusted to 1913 values, both for totals and per capita. The per capita figures are also given by grand totals and by states in some of the other sections, but the adjustment to 1913 dollars is not made. Presumably it was not considered feasible to carry the 1913 value adjustments all the way through the book, desirable as that might be. Such adjustments to 1931 dollars as are made take much of the edge off the common run of protest against the rising cost of government, but it should be noticed that the recent fall in prices reverses the curves somewhat.

A Constructive Report

PUBLIC HEALTH IN NEW YORK STATE: Report of the New York State Health Commission to Franklin D. Roosevelt, Governor (with a foreword by the latter). Cloth; 6x9 in.; pp. 504; tables, charts and halftones. For copies apply to State Department of Health, Albany, N. Y.

AMONG the data and recommendations of particular interest to engineers in this comprehensive study of "Public Health in New York State" are: (1) outlines of the methods employed in state control of public water supplies, sewerage and sewage disposal, industrial wastes and milk pasteurization; (2) recommendations that permits for new water supplies, so far as they relate to sanitary quality, be turned back from the state conservation department (water and power control division) to the state health department, in which they were vested for many years; (3) that the health department be given a larger control over water pollution by industrial wastes.

One of the most constructive and potentially far-reaching sections of the report sketches the weakness of local public health service in the 1,158 towns and villages of the state and recommends a transfer to the 57 counties, together with a strengthening of the service of the latter. Under the plan of centralization proposed, cities would have the option of retaining their health boards and health officers or else: (*a*) if of less than 50,000 population, discontinuing both and coming under the county board of health, with power to appoint one of its members; or (*b*) if over 50,000, joining in a city-county board, one-half of the members of which to be appointed by each component.

Technique of Welding

MANUAL OF ELECTRIC ARC WELDING—E. H. Hubert, M.A.I.E.E., Editor; formerly Assistant Editor of *Industrial Engineer* and *Electrical World*. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 163; halftones, diagrams and tables. $2.

SPONSORED by the principal manufacturers of electric welding equipment Hubert's "Manual" treats of the fundamentals of arc welding. Its sponsorship lends force to the recommendations made concerning choice of equipment, methods of making welds, preparation of the work and altered procedure for welding different ferrous and non-ferrous metals. A particularly useful chapter delineates a training course for welding operators and describes about 40 recommended exercises to be carried out with both the metallic and the carbon arc. The book should have a special appeal to contractors and operators desiring to improve their welding technique.

Money and How Used

A PRIMER OF MONEY—By Donald B. Woodward, Financial Editor, and Marc A. Rose, Editor, *The Business Week*. New York and London: Whittlesey House, McGraw-Hill Book Co. Cloth; 5x8 in.; pp. 261; diagrams and tables. $2.

IN THEIR "Primer of Money" two of the editors of *The Business Week* tell all that most of us need to know about money—except how to get it. Indirectly, light is thrown upon even that. The first part of the book gives "The Story of Money." The second part deals with "Money in the Modern World." In Part I there is a clear exposition of money standards, the gold standard, interest, banks and bank credit, the government in relation to money and banking, the Federal Reserve, exchange and the money market. Among the topics of Part II are money and prices, politics and money, booms and depressions, and post-war troubles. Most of the statistical data given are in an appendix, which is followed by a glossary, suggested readings and, what is too often left out of books, an index. In these troublous times, such a simply written authoritative book deserves wide circulation and careful reading.

Municipal Cost Accounting

MANUAL OF PUBLIC WORKS RECORDS AND ACCOUNTING for Cities of 10,000 to 40,000 Population as Installed in Winona, Minnesota—Published jointly by the Committee on Uniform Street and Sanitation Records and the League of Minnesota Municipalities. Paper, cloth back; 8x11 in.; pp. 81. $1 from the Committee on Uniform Street and Sanitation Records, 923 East 60th St., Chicago, Ill.

THE valuable cooperative work in one branch of uniform municipal records and accounting begun some two years ago by the Committee on Uniform Street and Sanitation Records has been continued, broadened and applied practically to Winona, Minn., a city of about 20,000. The earlier applications were made in Brunswick, Ga., and Kenosha, Wis. The latest installation follows "a simplified and more direct type of cost accounting" than was used at Brunswick and Kenosha; it covers motor equipment in greater detail; in addition it summarizes the principles and practice of municipal budgeting and accounting in general.

It should be understood that "public works" as represented in this manual are limited to street, sewer and railroad crossing maintenance and repair, with the addition of garbage and refuse collection and disposal. These works and services are all that are under the city engineer of Winona. This limitation is

in line with the name and original object of the committee, but the main title is nevertheless misleading—a fact that does not detract from the value of such forms and discussions as are given.

Innumerable Details and Standards

ARCHITECTURAL GRAPHIC STANDARDS for Architects, Engineers, Decorators, Builders and Draftsmen—By Charles George Ramsey, A.I.A., and Harold Reeve Sleeper, A.I.A. New York: John Wiley & Sons., Inc. London: Chapman & Hall, Ltd. Cloth; 9x12 in.; pp. 233, of which 212 pages are line cuts and other graphic materials and 16-p. index. $6.

EXCEPT for a brief preface, contents and a long and useful index, Ramsey and Sleeper's "Architectural Graphic Standards" is filled from cover to cover with drawings and tabular matter giving almost innumerable detail drawings, numerical and other information for architects, engineers and other classes named in the subtitle to the book. As the preface says, "building construction and procedure from foundation to furniture" is included. The volume should prove to be a time and money saver to thousands.

Ninety-Six Metropolitan Districts

METROPOLITAN DISTRICTS: Population and Area. Fifteenth Census of the United States: 1930. Prepared under the Supervision of Clarence E. Batschelet, Geographer. Paper; 9x12 in.; pp. 253, including a map for each district. 85c. from Superintendent of Documents, Washington, D. C.

GIVES total population and distribution of population by sex, color, native white and foreign born, and also by age, for each of 96 metropolitan districts having an aggregate population of 100,000 or more and containing one or more central cities of 50,000 or over. Similar figures are given for each central city, for other incorporated places and for unincorporated areas within each district. For each central city and the outside cities there are given the 1930 and 1920 populations and percentage of increase and also the 1930 land areas and populations per square mile. There is a short introduction of text and summary tables.

A Remarkable Utility

FIFTY YEARS OF NEW YORK STEAM SERVICE: The Story of the Founding and Development of a Public Utility. Boards, cloth back, inlaid pictorial title on cover; 9x11 in.; pp. 135; colored and other illustrations. Apply to New York Steam Corporation, 280 Madison Ave., New York City.

WELL WRITTEN and handsomely produced both as to text and illustrations, this book deserves high place in the historical and descriptive accounts of the industries and public utilities of the country. In its earlier pages it tells how Birdsill Holly, "father of district steam heating," did his pioneer work at Lockport, N. Y., and how Wallace C. Andrews introduced the system in the lower part of New York City a half-century ago. The story continues to the present day, when the successor of the original company has a half-dozen steam-generating stations capable of producing 7,250,000 lb. of steam an hour for distribution through 65 miles of pipe to buildings having contents of about 2.2 billion cubic feet out of a total of 14 billion feet in the borough of Manhattan. Among the engineering triumphs of the company are the development of pipe, joints and insulation and the use of powdered coal as fuel, as well as a metering system for all the steam sold.

Power From Pumped Storage

BARRAGES CONJUGUÉS ET INSTALLATIONS DE POMPAGE — Par Georges LaPorte, Ancien Élève de L'Ecole Polytechnique. Paris. Gauthier-Villars et Cie., Quai des Grands-Augustins, 55. Paper, 7x10 in.; pp. 142; diagrams and tables. 35 francs.

SUPPLEMENTING a study completed by the author in 1929 on the effect of storage reservoirs upon the flow of rivers and their power possibilities (Barrages Conjugués et Bassins de Compensation, *ENR*, Nov. 21, 1929, p. 821), the author, in the present study, takes up the possibilities of pumped storage in further developing the power output of rivers. The subject is treated by taking a number of hypothetical cases and working out the best solution for each. The principal pumped-storage hydro-electric plants of the world with their characteristics are listed.

Largely Descriptive

INTERNAL - COMBUSTION LOCOMOTIVES AND MOTOR COACHES—By Prof. I. Franco, Mechanical Engineer, late Professor at the Technical High School of Delft (Holland), late Superintendent of Motive Power, Electric Traction and Rolling Stock Department of the Netherlands Railways, and P. Labryn, Mechanical Engineer, Chief of Locomotive Construction Department of the Netherlands Railways. New York: Van Riemsdyck Book Service, 55 West 45th St. Cloth; 7x10 in.; pp. 249; photographs and line cuts. $4.

MUCH scattered information upon internal-combustion locomotives and coaches for railway service is gathered in this book (written in English). Begun by the late Prof. I. Franco, formerly superintendent of motive power of the Netherlands Railways, and completed by P. Labryn, chief of the locomotive construction department of the same system, the work was intended as a guide to anyone interested in knowing progress made to date in the application of internal-combustion engines to railway use. It is, therefore, largely descriptive. One short chapter is devoted to determination of engine power and another to conclusions to be drawn from the material presented in the book. The attention given to the application of internal-combustion engines to railway operations in this country is rather limited, most of the book being devoted to practice in Europe.

Publications Received

IRON AND STEEL production statistics for 1929 are given in a 56-p. quarto U. S. Census bulletin. Among the divisions of the bulletin are steel works and rolling mills, cast-iron and wrought pipe, both welded and heavy riveted. (20c. from Superintendent of Documents, Washington, D. C.)

THE URBAN POPULATION OF CANADA in 1931 is now available in mimeographed form. Comparable figures for 1921 are also given. Each city, town and incorporated village is listed by provinces. The census was taken under the direction of R. H. Coats, dominion statistician, and E. S. Macphail, chief division of census and vital statistics. (For copies address Dominion Bureau of Statistics, Ottawa, Canada.)

"SWIMMING POOL WORLD" is a promising monthly which appeared first in March. It is edited by Charles W. Wood and associates, including three engineers—Lee Holdridge, Wayne A. Becker and Wesley Bintz. Various phases of swimming-pool design and operation are covered. The April issue has an article on "The Chemistry of the Swimming Pool," by Francis D. West, a district sales manager for the Permutit Co. ($2 a year; Thornwood Publishing Co., East Stroudsburg, Pa.)

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

AIRPORT DRAINAGE AND SURFACING: Report of Committee Representing Aeronautics Branch, Department of Commerce, American Engineering Council, American Road Builders' Association. Paper; 6x9 in.; pp. 38; diagrams. Apply to Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.

ARE OUR BANKS BETRAYING US—By Alfred Wayland. New York: The Anvil Press, 424 West 33d St. Paper; 6x9 in.; pp. 17. 25c.

Written from the viewpoint of "Mr. Average Citizen" who feels strongly that he has been betrayed and in some cases ruined by his bank in recent years, through demands to reduce or pay off loans and through foreclosures when he feels that he should have been "carried" instead until better times—especially in view of idle capital. In conclusion the author asks: "Why have none of our banking authorities suggested such a moratorium?"

BESTIMMUNGEN DES DEUTSCHEN AUSSCHUSSES FÜR EISENBETON 1932. Berlin: Wilhelm Ernst & Sohn. Paper; 8x12 in.; pp. 72; diagrams. 2 marks.

BIBLIOGRAPHY ON STANDARDIZATION: Supplementary to lists in Standards Year Book, 1928-31. Paper; 6x9

in.; pp. 19. Apply to Bureau of Standards, Washington, D. C.

THE BONBRIGHT SURVEY OF ELECTRIC POWER AND LIGHT COMPANIES OF THE UNITED STATES. Revised to September, 1931. Arranged according to Geographic Divisions—Edited by G. F. Wittig, Statistical Editor *Electrical World*, and J. A. Stuart, *Electrical World*. New York and London: McGraw-Hill Publishing Co. Stiff paper; 8x11 in.; pp. 191; key map for each state. $10.

Eighth annual issue of a directory of electric light and power service in places of 2,500 or more, listed alphabetically by states, with key maps showing parent company supplying the service, together with local companies and municipal plants. For the parent companies and for such local companies as exist a few financial items are given.

THE BROOKLINE WATERWORKS AND F. F. FORBES—By M. N. Baker, Associate Editor, *Engineering News-Record*, Reprinted from *Journal*, N.E.W.W.A., March, 1932. Paper; 6x9 in.; pp. 92.

Historical and descriptive sketch from inception of works in 1872, when Mr. Forbes began on first day of survey. Relates chiefly to underground supply, tastes, odors and removal of iron and manganese.

CITY PLANNING AS A PROFESSIONAL CAREER — Henry V. Hubbard and Howard K. Menhinick. Reprint from *City Planning*, January, 1932. Paper; 5x8 in.; pp. 9. Free from Harvard School of City Planning, Cambridge, Mass.

DIE BERECHNUNG DES LÄNGENPROFILS EINES FLUSSES UND DESSEN ÄNDERUNG BEI EINSETZENDER EISBILDUNG—By Dr. Olaf Devik, Chr. Michelsens Institutt for Videnskap og andsfrihet, Bergen, Norway. Paper; 7x10 in.; pp. 13.

EARTH DAM PROJECTS—By Joel D. Justin, C.E., M.Am.Soc.C.E., Hydro-Electric Engineer, The United Gas Improvement Co. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 345; photographs and line drawings. $5.

THE EFFECT OF AGGREGATE AND OTHER VARIABLES ON THE ELASTIC PROPERTIES OF CONCRETE—By P. M. Noble. Bulletin No. 29, Engineering Experiment Station, Kansas State College, Manhattan, Kan. Paper; 6x9 in.; pp. 27; diagrams, photographic illustrations and tables.

ELEMENTS OF HUMAN ENGINEERING —By Charles R. Gow, President of Warren Brothers Co., Sometime Professor of Humanics at the Massachusetts Institute of Technology. Edited by F. Alexander Magoun. New York: The Macmillan Co. Cloth; 5x8 in.; pp. 169. $1.60.

EMSCHERGENOSSENSCHAFT U N D Lippeverband in den Jahren 1925 Bis 1930—Von Dr.-Ing. E. H. Helbing, Baudirektor des Emschergenossenschaft und der Lippeverbands, Essen, Germany. Paper; 9x11 in.; pp. 123; many line cuts and halftones. For copies apply to Dr. Helbing, as above.

FIELD MANUAL FOR BRIDGE INSPECTORS—By Prof. S. S. Steinberg, Head of the Department of Civil Engineering at the University of Maryland. Baltimore: State Roads Commission. Cloth; 5x8 in.; pp. 122; diagrams and tables.

Primarily for bridge inspectors under the Maryland Road Commission. Takes up duties, field equipment, surveys and investigations, construction, records and reports.

FINANCING SEWAGE DISPOSAL—By Howard R. Green. Bulletin 110, Engineering Extension Service, Iowa State College, Ames, Iowa. Paper; 6x9 in.; pp. 15; photographs.

HEAT ENGINES—By S. H. Moorfield, Head of the Mechanical Engineering Department, and H. H. Winstanley, Lecturer in Mechanical Engineering, Wigan and District Mining and Technical College. London: Edward Arnold & Co. New York: Longmans, Green & Co. Cloth; 5x7 in.; pp. 287; line cuts and tables. $2.25.

Designed for British students "who aim at obtaining the ordinary national certificate in mechanical engineering."

THE HOLDING COMPANY: Its Public Significance and Its Regulation—By James C. Bonbright, Professor of Finance, Columbia University, and Gardiner C. Means, Columbia University. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 398. $4.

HOME FINANCE AND TAXATION: Reports of the Committees on Finance, Frederick H. Ecker, Chairman; Taxation, Thomas S. Adams, Chairman—Edited by John M. Gries and James Ford. Cloth; 6x9 in.; pp. 278; tables and diagrams. $1.15 from the President's Conference on Home Building and Home Ownership, Washington, D. C.

HYDRAULICS OF OPEN CHANNELS—By Boris A. Bakhmeteff, M.Am.Soc.C.E., M.Am.Soc.M.E., Professor, Columbia University; formerly Professor, Polytechnical Institute, Petrograd, Russia. [Engineering Societies Monographs.] New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 329; diagrams and tables. $4.

LATERAL SEDIMENTATION: The cause, natural laws, cases and forces involved discussed—By James W. Pearl, 763 East 37th St., Chicago, Ill. Paper; 6x9 in.; pp. 15; diagrams and tables. Apply to author for price.

A mathematical discussion of "a method of collecting extremely fine solids, when freely floating or suspended in a fluid, by local attraction," is followed by descriptive matter which leads up to an outline of a "slow-spiral-flow basin" patented by the author.

MUNICIPALLY OWNED ELECTRIC UTILITIES IN NEBRASKA—By Paul Jerome Raver and Marion R. Sumner. [Studies in Public Utility Economics, Research Monograph No. 5, Richard T. Ely, Editor.] Chicago: The Institute for Economic Research, 337 East Chicago Ave. Paper; 7x10 in.; pp. 61; tables, spot maps and diagrams. $1.50.

Gives "numerical and technological history" of growth and recent decline of municipal ownership of electric light plants in Nebraska; "statutory and constitutional provisions and court decisons affecting public ownership"; and causes of ownership changes. Tabular data are extensive and detailed; diagrams are interesting and illuminating.

NATIONAL DIRECTORY OF COMMODITY SPECIFICATIONS: Classified and Alphabetical Lists and Brief Descriptions of Specifications of National Recognition —Prepared by Clarence W. Ingels under the direction of A. S. McAllister, Chief of the Division of Specifications, Bureau of Standards. Cloth; 8x11 in.; pp. 547; $1.75 from Superintendent of Documents, Washington, D. C.

Revision of directory of 1925. Classified under such main heads as animal and animal products; chemicals; ores, metals and manufactures; machinery and vehicles; nonmetallic minerals; wood and paper. An index of 48 pages in small type is required to show the thousands of commodities listed.

OUTLINE OF METHODS FOR ESTIMATING GROUNDWATER SUPPLIES—By Oscar Edward Meinzer. Water-Supply Paper 638-C, U. S. Geological Survey; from Contributions to the Hydrology of the United States, 1931. Paper; 6x9 in.; pp. 144; 10c. from Superintendent of Documents, Washington, D. C.

Summarized descriptions of methods and discussions of subject, from early to recent times; with footnote references to earlier publications. Little in the way of conclusions except need of further study and commendation of water-stage recorder for wells.

THE PORT OF PORTLAND, OREGON [Revised, 1931]—Prepared by the Board of Engineers for Rivers and Harbors, War Department, in cooperation with the Bureau of Operations, U. S. Shipping Board. Paper; 6x9 in.; pp. 162; many illustrations, including folding maps and tables. 50c. from Superintendent of Documents, Washington, D. C.

RECOVERY: The Second Effort—By Sir Arthur Salter, K.C.B. New York: The Century Co. Cloth; 6x9 in.; pp. 346. $3.

REGIONAL PLANNING: The Region—Past, Present and Future. A Digest of the Policies, Principles, Procedure and Findings of the Regional Planning Federation of the Philadelphia Tri-State District (1420 Walnut St., Philadelphia, Pa.) Stiff Paper; 8x11 in.; pp. 54; photographic illustrations and folding map.

REINFORCED-CONCRETE PAVEMENTS AND BASES, Recent Practical Developments in the Design and Construction of —Bulletin 25, American Road Builders' Association, Washington, D. C. Paper; 6x9 in.; pp. 47; diagrams and halftones. Presumably free on request.

Monograph by a committee headed by C. E. Foster, chief engineer, state highway department, Lansing, Mich., with whom were associated a representative, each, of the Wire Reinforcement Institute and the National Crushed Stone Association, both located in Washington, D. C.; and engineers officially connected with street or highway work in two states, one county, one city and the District of Columbia.

STANDARDS YEAR BOOK, 1932—Compiled by the U. S. Bureau of Standards. Cloth; 6x9 in.; pp. 394. $1 from Superintendent of Documents, Washington, D. C.

Sixth issue. Presents "a picture of the standardization movement in various fields of industry conducted by certain national and international agencies." Gives special attention to current American programs.

STATISTICAL ABSTRACT OF THE UNITED STATES, 1931. Cloth; 6x9 in.; pp. 898; tables. $1.25 from Superintendent of Documents, Washington, D. C.

STONE & WEBSTER 1888-1932: A brief account of the history of this organization and of the services developed during 44 years. Cloth; 6x9 in.; pp. 30; two-color pen sketches. Apply to the firm, 90 Broad St., New York.

SURVEY OF NORTHERN AND NORTHWESTERN LAKES: To Supplement the Information Given Upon the Charts of the Great Lakes and Issued with those charts. Detroit, Mich: U. S. Lake Survey Office Paper; 8x10 in.; pp. 474; tables.

Revision of earlier bulletin, which it supersedes. Gives data on rivers and harbors and improvements carried on by the U. S. Engineer Offices on these waters.

TACONY-PALMYRA BRIDGE Over the Delaware River between Philadelphia, Pa., and Palmyra, N. J. Final Report to the President and Directors of the Tacony-Palmyra Bridge Co. (Palmyra, N. J.)—By Modjeski, Masters & Chase. Stiff paper; 9x12 in.; pp. 62; photographs and folding diagrams.

TESTS OF JOINTS IN WIDE PLATES: Report of an Investigation Conducted by the Engineering Experiment Station, University of Illinois, in cooperation with The Chicago Bridge & Iron Works—By Wilbur M. Wilson, James Mather, Charles O. Harris. Paper; 6x9 in.; pp. 74; halftones; diagrams and tables. 40c. from Engineering Experiment Station, Urbana, Ill.

THERMODYNAMICS, Proposition for the Correction and Renewal of—By Toivo W. Salonen. Helsingfors, Finland: Akademiske Bokhandeln. Paper; 7x10 in.; pp. 32; 7 figures in the text. 80 cents.

The author, who describes himself as "a qualified civil engineer," holds the theory of Clausius is "erroneous," that "energy seems to be not indestructible," and submits a "practical experiment proving the destructibility of energy." In succession he has published the results of his studies in Finnish, in German and now in English. He has additional data and conclusions awaiting publication in English, which he hopes will not be prevented by the present economic depression.

TREATED LUMBER, ITS USES AND ECONOMIES—Report of the Subcommittee on Retail Distribution of Treated Lumber of the National Committee on Wood Utilization. Fifteenth report of a series on the marketing and use of lumber. Paper; 6x9 in.; pp. 42; photographs and maps. 15c. from Superintendent of Documents, Washington, D. C.

ZUR FRAGE DER KUNSTLICHEN BAUAUSTROCKNUNG—Von Dipl.-Ing. R. Dittrich, Berlin und Dipl.-Ing. D. Rosslein, Paris. Paper: 8x12 in.; pp. 28; tables and 43 line cuts and halftones, 4.5 marks from VDI Verlag GMBH, Berlin, NW7, Germany.

Description, with mathematical discussion, of a system for drying out of new buildings by heat and ventilation to hasten the time of their being ready for occupancy.

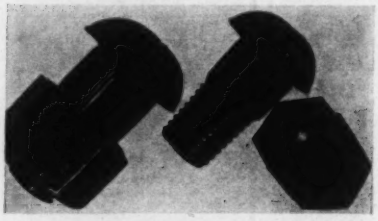
New Rivet-Bolt Exhibits Promising Qualities in Laboratory Tests

COMPLETION this week of a test program at the testing laboratories at Columbia University in New York on a fastening for structural-steel joints, known as a rivet-bolt, serves to focus attention on this interesting new fabricating part, which it is claimed can be used to advantage in place of rivets.

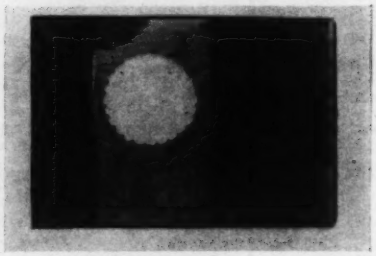
The tests have indicated that joints made with the rivet-bolts are less subject to slip than riveted joints, that rivet-bolts and rivets made from the same stock have about the same shear resistance, but that, in contrast to rivets, rivet-bolts can be made of high-strength alloy or heat-treated steels, making possible joints of much higher strength than riveted joints.

The program just completed involved some 30 multiple-bolted and riveted tension specimens and supplemented an earlier program in which single bolts and rivets were used to connect bar stock plates. The results of the latest series of tests, in which ½-, ⅝- and ¾-in. plates joined by three or five rivets or bolts in both single and double shear were pulled in a standard tension testing machine, are not yet officially available, but in general they correspond to those of the first series that were published in Report 2,283, dated Jan. 20, 1932, of the Columbia University testing laboratories.

The rivet-bolt, commercially available in diameter sizes from ⅜ to 1 in., has a standard rivet head, is threaded on the opposite end with a special screw thread, made self-locking by virtue of tapered faces at the root that engage similar tapered faces at the crest of the nut thread, and a shank into which ribs or fins are cold-rolled parallel to the axis of the bolt. The diameter of the bolt itself is made 1/16 in. less than that of the hole into which it is to be driven (the same as for rivets), while the diameter of the ribbed section is made 1/32 in. larger than the hole. The ribbed shank is the essentially new characteristic of the rivet bolt, the self-locking thread having been in service in numerous bolt applications for several years. In use, the rivet-bolt is driven manually by means of a 5- or 7-lb. hammer, the ribs biting into the metal of the plates (the extent of the bite depending upon the relative hardness of the bolt and plate metal) and providing a maximum of bearing surface to resist displacement and to allow full shear development. The nuts, tightened with a wrench, produce the needed tension in the shank. According to the Dardelet Threadlock Corp., New York City, originators of the rivet-bolt and owners of the screw thread patents, the first large order for rivet-bolts has recently been placed by the Callahan Construction Co., of St. Louis, and involves 20,000 ¾- and ⅞-in. bolts to be used in numerous temporary construction-plant structures on its Madden Dam work in Panama.



Rivet-bolts are driven manually, produce a well-filled hole by virtue of the ribs on the shank that bite into the plates, and are held securely in place against tension or vibration by a self-locking nut. High-strength steels may be used.



Machined and etched specimen, showing how the ribbed shank, 1/32 in. larger than the hole, fills the hole after the rivet bolt is driven.

From the fifteen specimens tested in the first program it was indicated that the bolted lap joints were stiffer than the hot-driven-rivet joints. Curves representing the behavior of the rivet-bolt connections showed no pronounced slip but rather a gradually increasing rate of displacement with applied load. There was little difference in amount of slip with bolts made from structural-grade rivet steel or higher-strength steel up to the yield point of the lower strength material. Displacement or slip of the joint at the yield point of the structural-grade rivet-steel bolt was about 0.0065 in.; the corresponding slip of the hot-riveted joint was 0.0173 in. The relative ultimate shear strength of rivets and bolts of structural-grade rivet steel was 44,808 and 42,780 lb. per sq.in., respectively. As stated, the results of the multiple-bolted joints in the program just completed will closely parallel the earlier results.

In the second program, joints using bolts of high-strength boiler specification steel and others of 1.4 per cent manganese steel were included. A three-bolted specimen using the manganese bolts carried a maximum load of 109,800 lb., indicating a shearing strength per bolt of about 80,000 lb. per sq. inch. This ability to use bolts of high manganese or other alloy content is believed to be one of the chief factors that give the bolt an advantage over rivets. Other advantages may be cited as a reduction in construction noise and an elimination of the equipment necessary for riveting. The use of high-strength bolts may also permit the design of more compact joints than are possible with the lower-strength rivets.

It is contemplated that permission will be asked to use the bolts in New York City building work, and the tests just completed were witnessed by the building inspectors of the five boroughs of the city: Thomas Heatley, Bronx; Ray Q. Hannan, Richmond; J. E. Herman, Manhattan; James Sheehan, Brooklyn; and James Coleman, Queens.

Letters to the Editor

Self-Imposed Depression

Sir—The recent articles in *Engineering News-Record* concerning the condition of the cement industry have doubtless impressed the reader with the fact that something is radically wrong with this industry. A closer study of certain other related facts would soon lead to the conclusion that until this year the industry should have been in only slightly embarrassed condition but for its own methods. The total decrease in volume of sales had been considerably less than in most industries, but while others—notably the railroads—had materially reduced their operating costs, the cement group had reduced its selling prices (or more exactly its selling price) very greatly, in fact to a point below that at which it could either make a profit on its sales or even make cement.

The articles have presented the thought that as a result of a number of conditions there exists a too great potential plant production. Perhaps such a condition is not to be blamed entirely upon the industry. It is possible that a condition had existed which, by insuring attractive return, enticed fresh capital into the field; the latter did indeed occur. New capital became interested in entering the industry through rather far-sighted speculation, noting that there had been improvements in plant processes (resulting in material reduction in manufacturing costs and increase in quality of the product) that had too frequently not been adopted by the older organization in the field. Therefore an attractive opportunity presented itself

for erecting new plants in old producing fields. The opportunity was seized, and many of the new mills are now discovered to be more successful than the older ones.

A good part of the claim of potential overproduction is directly chargable to the industry, however. It is still frequently carrying on its books (and attempting to use for the production of up-to-date cement) too many plants that even a second-rate junk dealer would consider anything but an adornment to his yard. The figures furnished the Department of Commerce by the industry showing its rated plant production are subject to a discount of at least 20 per cent. They are most interesting as a reflection of the modern "keeping up with the Joneses" spirit. A plant that is operated only to hold a certain field during peak times, and is even then operated only at a loss, should hardly be used to substantiate figures that serve only to bolster up the many psychological ramifications of reputed excess of capacity. Nothing need be said of the plants that are so hopelessly obsolete that it is really a waste of paper and ink to record them as capable of operating without loss at far better prices than have existed during the past several years.

Such facts as these, as well as those presented in the articles, lead one to reflect somewhat regarding what should be done to protect the general public, which in the end must absorb the resulting economic losses.

Can we have a mild but forceful and effective revolutionary action on the part of the stockholders, which will result in the elimination of the executives who have shown their inability to direct constructively an essential industry? This might be done, but in many cases the stockholders are the executives, and their continuing to act as such indicates their confidence in their own abilities, which present conditions (and the general business depression is not included in these) have shown to be most faulty.

Can we have a "Judge Landis" for the cement industry? Too many of these industrial dictators have appeared most advantageously in their ability to anticipate the wishes of their employers and to act accordingly. As a corrective of undesirable conditions this procedure has been a failure more frequently than a success.

Can we have more governmental paternalism, as unfortunate as this would be? It has been the attempted corrective in too many cases, and unfortunately in those cases where the public became too much the sufferer. Is there not already functioning a governmental agency that can step in when such unfair business methods are followed as cutting the price below that insuring adequate return upon a proper capitalization, not to mention cutting below the cost of production?

Instead of such procedure would it not seem possible that some friend or friends of the industry could be elected by it (or if this is impossible forced upon it by some well-meaning outsiders), who could bring about the needed amalgamation of the present corporations and welding of the resulting groups into a homogeneous whole having one unified purpose? This will require a herculean effort, but it is rather a large giant that is in the throes of mental and physical ills. The financial wizard who could bring about a new alignment of corporations through the method of pre-depression days is out of the question as a possible agent for making the effort. He has been found to have been just a typical side-show wizard—making *nothing* out of *something*. Nor can the Hercules be an economist, for economists have demonstrated too great proficiency in explaining why depression occurs and too little ability in foretelling the economic future.

Aside from the many things he should not be, this guiding angel must have deep knowledge of the existing conditions, a thorough understanding of the industry and its dependent public, and a personality that will win the confidence of those financially interested in it, either in earning a livelihood or in receiving a source of income. Unless something is forthcoming we can expect an era of receiverships, bankruptcies and financial difficulties that will result in the public losing a great deal of its interest not only in the making of cement but also in the using of it.

AN INTERESTED OBSERVER.

Infiltration Into Sewers in Los Angeles

Sir—Infiltration of groundwater into sanitary sewers is, of course, a most important matter. The expense of increased capacity of outfall sewers, pumping plants and sewage-treatment plants is increased in direct proportion to the amount of infiltration.

It has been the custom of the bureau of engineering of the city of Los Angeles, of which J. J. Jessup is city engineer, for several years past at the time of final inspection of a sewer system to note whether or not there is any flow of groundwater into the sewer, and in those cases where any exists, it is measured accurately by means of a metal triangular weir, which is placed in the sewer line at the lowest manhole. Any individual leaks that are visible on final inspection, by means of a reflected beam of sunlight, are stopped, even though the total amount of infiltration may be within the specification limits which permit a maximum leakage of 0.6 gal. per minute per inch of internal diameter per 1,000 ft. of wet trench. This is equivalent for 8-in. pipe to 36,495 gal. per mile per day. This latter unit of measurement is the one commonly used throughout the country.

Records of our sewer construction and infiltration of ground water by calendar years are as follows:

Calendar Year	Total Miles of Sewer Constructed	Total Miles in Wet Ground	Leakage, Gal. Per Day Per Mile of Sewer in Wet Ground
1927	420.73	18.03	14,111
1928	229.93	6.36	15,670
1929	209.14	5.26	8,843
1930	328.82	1.29	5,782
1931	177.96	22.76	1,873
Range in five years			0 to 38,769

On five projects out of a total of 28, comprising 11.24 miles out of a total of 53.70 miles of sewer laid in wet ground in the five-year period, there was no leakage.

Most of the late sewer mileage has been of 6- and 8-in. pipe, but several miles of large monolithic semi-elliptical sections and circular reinforced-concrete pipe are included. Our general practice in recent years has been to use metal gaskets and forms in pouring joints on sewers of small diameter in water-bearing ground.

HERMAN P. CORTELYOU,
Engineer of Construction, Bureau of Engineering.

Los Angeles, Calif.
April 19, 1932.

"Power Ethics"

Sir—The April 21 issue of *Engineering News-Record* contained reviews of three books: "Power Ethics," "The Public Pays" and "Power and the Public."

I have not had an opportunity to examine "The Public Pays" and "Power and the Public." I have read "Power Ethics," and I am also quite familiar with the testimony that was given at the Federal Trade Commission investigation. I am also familiar with the operation of the private utility field and the work and operation of the National Electric Light Association. The person who wrote the review of "Power Ethics" was wholly uninformed on the subject with which the book deals, and he has accepted at face value a book that was written purely as a piece of propaganda by an active worker on the staff of an organization that is working for public ownership.

"Power Ethics" warps, twists, misinterprets and does all sorts of violence to the testimony that it claims to be reporting. The book is either the product of one totally ignorant of the subject with which he is dealing or else it is a deliberate attempt to mislead its readers. My personal opinion is that the latter is the case.

DANIEL A. HILL,
The Ohio Public Service Co.

Cleveland, Ohio.
May 2, 1932.

EDITOR'S NOTE—As stated in the review, the citations in "Power Ethics" are from testimony before the Federal Trade Commission, to which page references are given in each case. The citations and comments in "Power Ethics" agree in tenor with those in "The Public Pays."

NEWS OF THE WEEK

Registration for Architects and Engineers in Connecticut

A movement looking toward the registration of architects and engineers in the state of Connecticut was begun at a meeting held in Stamford May 11. Following a discussion of the subject by D. B. Steinman and Arthur V. Sheridan, president and past-president of the New York State Society of Professional Engineers, by Lester B. Scheide, architect, and Robinson Buck, engineer, a committee was appointed to prepare the outline of an organization and to report to a second conference to be held May 25. Willard S. Conlon, city engineer of Stamford, is chairman of the committee.

Los Angeles City Employees Receive 10 Per Cent Pay Cut

Reductions by 10 per cent of the salaries of all Los Angeles, Calif., city employees receiving more than $100 per month were voted May 9 by the city council, the reductions to become effective July 1. These cuts, which are expected to effect a saving of $1,000,000, will take the place of the graduated salary reductions, ranging from 2 to 10 per cent, recently voted by the council and now in effect. The latest reductions will affect 3,500 employees. Police and fire department members, whose compensation is fixed by an initiative ordinance, are not included.

Collusion Alleged in Minnesota Paving Contracts

Taxpayers' suits have been filed in the district court of Ramsey County (St. Paul), Minn., asking cancellation of six state highway paving contracts awarded Nov. 10, 1931. The claims are made that there is an excessive profit of more than $500,000 in these six contracts and that the rule requiring prequalification limited the number of eligible bidders so narrowly that the prequalified contractors were able to parcel out the work among themselves at predetermined prices.

Gov. Olson has ordered an investigation into prices paid by the state for paving projects.

Los Angeles Water and Power Commissioners Dismissed

Conflicting policies in the management of the Los Angeles, Calif., department of water and power came to a head on May 6 when Mayor Porter removed John R. Haynes and A. F. Southwick, water and power commissioners, from office immediately after they had refused to resign. The mayor's action came during a meeting of the commission at which the administrative consolidation of the water and power departments was terminated and the resumption of the former two-bureau plan of administration was voted.

The action by the mayor requires the assent of the city council, which has referred the matter to a committee. If the council fails to sustain the mayor the controversy can be taken to the people on a recall petition, and Mayor Porter intimates that this will be done.

The resolution ending the administrative consolidation, with H. A. Van Norman as general manager and chief engineer, provides that Mr. Van Norman take charge of the bureau of waterworks and supply and that E. F. Scattergood become general manager of the bureau of power and light. The salaries of each of these officials are reduced from $24,000 to $18,000 a year.

The return to the dual management system for the department of water and power was recommended by the city council's special water and power investigation committee which filed its report recently. Mayor Porter termed this report "biased and prejudiced."

Hetch Hetchy Bids to Be Opened June 6

Bids for the remaining work on the Coast Range tunnels of the Hetch Hetchy water-supply system for San Francisco will be received until June 6. The city's new charter provides that work exceeding $1,000 in cost must be handled by contract. However, the engineering division of the Hetch Hetchy construction department will submit a bid. Funds for the work will be supplied from the sale of $6,500,000 bonds, issuance of which was authorized May 3.

Tri-borough Bridge Planning at New York to Continue

An appropriation of $75,000 has been made by the New York City Board of Estimate to permit the work on plans for the tri-borough bridge to continue. Work on the construction of the bridge has been held up for lack of funds.

American Engineering Council Indorses Public-Works Program

Administrative board approves of proposal put forward by American Society of Civil Engineers but rejects proposal to lend federal credit to states and municipalities for public work

Washington Correspondence

THE administrative board of American Engineering Council united on May 13 in commending President Hoover's program for financing public and private construction through the Reconstruction Finance Corporation, ratified the principle, as proposed by the American Society of Civil Engineers, that a normal program of public-works construction is the most effective immediate means of stimulating business recovery, but rejected the further recommendation of the society's executive committee that Congress be urged to lend the federal government's credit to solvent states, counties and municipalities to carry out necessary and productive public works.

Announcement of the President's program on the morning of the meeting served principally to confuse the issue. Each of the opposing factions claimed that it was consonant with their ideas, but otherwise it received little consideration, as no one had had an opportunity to digest its provisions. A three-hour debate started when John L. Harrington brought in the report of council's committee on governmental expenditures, including the civil engineers' plea for a normal program of public works but omitting any suggestion on the method of financing. The board finally voted to accept the report of the civil engineers, with instructions that a committee of council be appointed to cooperate in achieving its objective, with a reservation that the method of financing be modified in harmony with council's position.

A leader in the offensive for adoption of the Am.Soc.C.E. recommendation for federal loans to solvent states, counties and municipalities, John P. Hogan declared that it is in substantial accord with the Hoover program and that the best thing council can do is to join the civil engineers in shaping the legislation. The only thing against a normal public-works program, he said, is the question of financial expediency. Estimating the number of unemployed at 15,000,000, Col. Hogan asserted that they will have to be taken care of or there will be a social revolution.

Nationwide program needed

The one recourse available, Col. Hogan contended, is a nationwide program of state, county and municipal construction to be financed by their bond issues, reinforced during the emergency period by the credit of the federal government in order to insure reasonable interest rates.

Referring to the improved tone of the market for municipal bonds, John L. Harrington asserted that council is fighting a shadow, as the solvent municipalities referred to in the Am.Soc.C.E. resolution have no difficulty in obtaining funds. The fact is, he said, that the municipalities themselves are unwilling to go forward. L. B. Stillwell asserted that the civils' resolution assumes that any method of financing would be satisfactory, when a large bond issue would be disastrous. His objection to the civils' resolution is not to its

object but because of its indefiniteness and its likelihood to be so construed that Congressmen would quote engineers as favoring a broad program even if it required a large bond issue.

Chairman Lee opposes

William S. Lee left the chair to express his "unalterable opposition" to the civil engineers' resolution. If a normal program of public construction can be financed by the Reconstruction Finance Corporation, he said, it is already taken care of. The civil engineers, he said, contend that the federal government's credit is necessary to support solvent municipal governments. If solvent, argued Mr. Lee, they can get the money; if not, it would be financial folly for the United States government to advance funds.

The controversy was closed when Gen. R. C. Marshall, Jr., urged that council recommend only a normal program of public works, leaving "to those responsible" the method by which it shall be accomplished. Council in its wisdom, said Gen. Marshall, should remain silent on this question. The subject is still in flux and it would be a mistake, he said, for council to make a positive statement at this time.

Gen. Marshall presented the amendments that have been recommended to the bill for creating an Administration of Public Works. The effect of the amendments would be to clip the wings of the army engineer corps by providing that the Administrator of Public Works may use but is not required to use the services of engineer officers.

Other matters acted on

Acting on the recommendation of its public affairs committee, the board voted to oppose actively the Carley-Barbour bill to provide that on government building repair jobs of more than $1,000 those responsible should prepare separate plans, specifications and blueprints for plumbing and gas fitting, heating, ventilating and steam-power, and electrical equipment, so as to permit independent bids on each class of work. With reference to the Parker bill to bring the inland waterways under jurisdiction of the Interstate Commerce Commission, the board adopted the recommendation that a subcommittee consider the question of bringing all forms of transportation under federal regulation. The board went on record in favor of repeal of recapture by the government of the excess earnings of railroads, as proposed in the Rayburn bill reported by the House committee on interstate commerce, but decided against taking any action on provisions of the same bill for bringing railroad holding companies under I.C.C. jurisdiction.

The board voted to support the Logan bill for consolidating the personnel activities of the federal government unless substantially the same results are accomplished by the government economy bill now pending. The Norbeck-Kerr bill that would authorize the director of public buildings and public parks to employ engineers and other expert consultants was indorsed. Limiting the work week on government work to 35 hours, as proposed in the Jones bill, was opposed. The board went on record as opposing the bill of Senator Thomas, of Idaho, to require contractors on government work to pay claims for labor and material within 30 days under penalty of being debarred from bidding for three years.

Dean F. L. Bishop, representing the Society for the Promotion of Engineering Education, and G. H. Fenkell, representing the Detroit Engineering Society, were admitted to the assembly, on the recommendation of the committee on membership and representation. The board indorsed the movement for creation of state engineering councils to be directed by a committee of council rather than by the joint committee of founders' societies that has functioned to date.

On the recommendation of Baxter L. Brown, chairman of the flood-control committee, the board voted that council should not support the levee setback bill in its present form, as its purpose is not clearly defined.

The executive committee was instructed to cooperate with the American Institute of Consulting Engineers in the movement to prevail on investment bankers to obtain reports by independent engineers on foreign projects which they propose to finance. Col. Hogan reported that the attitude of the bankers toward this proposal is much more receptive than it was prior to the depression.

Baltimore Awards Contract for New Hospital

The board of awards, Baltimore, has awarded a contract for the construction of a general hospital building in the City Hospitals group to the low bidder, J. Henry Miller, Inc., Baltimore, at that firm's bid of $847,700.

NEW LOUISIANA STATE CAPITOL

The new State Capitol of Louisiana at Baton Rouge was opened on May 16. It stands on the old campus of the Louisiana State University, a plaza 2,000 ft. long and 1,000 ft. deep, facing the city and backing up on the Mississippi River. The building, of steel frame construction with tile floor arches, is 450 ft. high, and, excepting the Washington Monument, is the tallest structure in the South. It is supported on 2,800 concrete piles and involved 4,200 tons of structural steel. The first four floors, with an area 340x150 ft., will house the legislature and the supreme court. The state offices will be in the tower, which is 70x70 ft. in plan. The structure was built by the George A. Fuller Co., of New York, at a total cost of $5,000,000, including furnishing and landscaping. The architects were Weiss, Dreyfous & Seiperth, of New Orleans.

Construction by Electric Railway Subject to I.C.C. Control

The Piedmont & Northern Ry. has lost its long fight to carry forward the construction of two extensions without receiving authority from the Interstate Commerce Commission. The Piedmont & Northern is an electrically operated line in North Carolina. It sought to extend its line from the southern terminus in North Carolina to Spartansburg, S. C., about 55 miles, and to build north from Charlotte to Winston-Salem, N. C., a distance of 75 miles. Construction was opposed by the Southern Ry., which it parallels. The Interstate Commerce Commission took up the case, claiming that under the Transportation Act the line could not be built without its approval. The railroad countered with the claim that it was an "interurban electric railway" and as such was, under the same act, exempted from the commission's jurisdiction.

The supreme court has decided in favor of the commission. It holds that regardless of the fact that the P. & N. is operated by electricity it is "a carrier whose major activity is the transportation of interstate freight in trains of standard freight cars," and as such is subject to the jurisdiction of the I.C.C. The court stated further that a steam-operated railroad could not remove itself from the jurisdiction of the I.C.C. simply by changing over from steam to electric operation.

Hoover Dam Notes

A total of 1,400 ft. of 15-ft. bottom bench was driven in the diversion tunnels at Hoover Dam during the week ended May 7. Out of the total length of the four tunnels, 15,905 ft., 14,257 ft. of bottom bench has been removed. Trimming operations preparatory to concrete lining placing totals 14,508 ft.

* * *

The pioneer heading for the Arizona spillway tunnel and the shaft from the adit connected May 3. Work was stopped on the Nevada spillway tunnel May 7 to allow the invert excavations in tunnel No. 1 to be completed.

* * *

In tunnel No. 2, the trash rack structure at the inlet and the floor of the transition, 50 ft. in length, had been completed and 768 ft. of invert had been poured May 7. The trash rack had been completed in tunnel No. 3 and 784 ft. of invert and 224 ft. of side wall had been poured. In tunnel No. 4, 1,131 ft. of invert had been poured. In all the tunnels a total of 2,647 ft. of invert section and 224 ft. of side wall had been poured.

* * *

During the week under review the concrete mixing plant turned out 3,330 cu.yd. of concrete, using 4,470 bbl. of cement. Sand and gravel now are kept moist from screening plant to mixers, thus giving improved control of mix consistency.

* * *

Drilling and blasting are continuing on the Black canyon highway. The cooling system in the administration building at Boulder City is 70 per cent complete. All conduits are in place and one motor-driven condenser has been mounted.

New York Regional Plan Units Merge Into One Group

The merger of the planning and engineering staffs of the Committee on the Regional Plan of New York and Its Environs with the Regional Plan Association has been announced. The committee, appointed in 1921 and financed by the Russell Sage Foundation, having fulfilled its function, now ceases to exist, but several of its members will continue in close association with the Regional Plan Association, a voluntary citizen body which is promoting the public acceptance of the regional plan proposed by the committee.

Harold M. Lewis, engineer of the Regional Plan committee, heads the association's engineering staff and will be responsible for keeping the plan up to date. Thomas Adams, who directed the making of the regional plan, has been engaged as planning consultant.

Sanitation and Water Course at Southern California University

At the fifth annual institute of government to be held at the University of Southern California June 13 to June 17, Ray F. Goudy, sanitary engineer, department of water and power, Los Angeles, and vice-president, California Section, American Water Works Association, will lead the section in water supply and sanitary engineering. Mr. Goudy will give three lectures and will preside at the round-table discussion and reading of papers following the main lecture at each afternoon session. Harrison P. Eddy, consulting engineer, Boston, will also lecture before the sanitary engineers on June 15 and 17.

Peter Diederich, superintendent of water and power, Glendale, Calif., is chairman of the water supply and sanitary engineering group.

Building Trades Strike at New York Ends

The strike of building trades which has held up much construction work in New York City since the first of May due to failure to reach a satisfactory agreement as to wage reductions proposed by the Building Trades Employers Association was broken on May 17 when representatives of most of the labor organizations agreed to accept reductions ranging from 20 to 30 per cent. The agreement does not cover a few unions not represented in the Building Trades Council.

Swope Unemployment Plan Receives First Approval by Industrial Group

THE unemployment relief proposals put forward by Gerard Swope, president of the General Electric Co., in September last (*ENR*, Sept. 24, 1931, p. 513) were sanctioned by the National Electrical Manufacturers Association at its meeting held in Hot Springs, Va., May 16. This is the first association to move toward putting the Swope proposals into effect.

In normal times the plan will be applicable to 200,000 workers in the shops of the 300 members of the association. It includes all employees who have served twelve consecutive months in either wage or salary relation and whose full-time compensation does not exceed $2,500 per year, and its institution is conditioned on acceptance by a minimum of 60 per cent of such employees. Except when his earnings are below 50 per cent of normal, each such "participating employee" contributes 1 per cent of his actual wage over a period of five years, and the company matches his contribution. These contributions must have been made throughout six consecutive months before an employee is entitled to benefits.

How payment is made

Provision is made for two unemployment conditions—namely, normal and emergency. Under normal conditions and after an initial unemployment aggregating two weeks, a participating employee receives 50 per cent of his normal average earnings (but not more than $20 per week) for a period not exceeding ten weeks in any twelve consecutive months. Provisions for part-time employment are also incorporated.

An unemployment emergency begins when payments from the fund exceed 2 per cent of the normal pay rate of all participating employees, and with its announcement normal contributions and payments cease. Thereupon all company employees (excepting only those receiving 50 per cent or less of normal) contribute 1 per cent of their pay throughout the period of emergency. This includes non-participating as well as participating employees, those with less than one year's service, sales, clerical and supervisory staff, and also company officers—without salary limitation and whether or not eligible for benefit. The company matches these contributions.

Emergency payments

Emergency payments are made to employees laid off or working part time and (after any residue of normal contribution has been exhausted) in amount and for periods set by the administrators and based on the financial need of the applicant and the funds available.

Seventy per cent of the normal fund is available only for unemployment benefit. Twenty-seven per cent may be used as a revolving fund for loans to participating employees, as approved by the administrators but not exceeding $200 per person. Three per cent may, in the discretion of the administrators, be available for the relief of any needy employee or pensioner. The administrators are selected half by the participating employees and half by the company.

Provisions are made for the refund to a deceased or departing employee of his interest in the fund and for corresponding refund to the employer, for guarantee by the employer of 50 per cent employment, in which event the employer's contribution ceases, for the appointment and powers of trustees to act as custodians of funds, and for the conditions under which the plan may be terminated.

April Building Permits Rise Above March Figures

Building permits reported for the month of April show a slight increase over the previous month, but the percentage loss for the four months of the year over a similar period last year is increased when compared with the first three months of the year. April permit figures show a loss of 69 per cent from the same month in 1931. Total building permits issued since Jan. 1 show a loss of 65 per cent from a similar period last year. This is an increased loss of 1 per cent over comparisons with the first quarters of 1931 and 1932. Building permits reported by 50 representative cities are shown in the accompanying table, as are also the estimated total permits for the entire country. Figures for the 50 cities were reported by S. W. Straus & Co.

BUILDING PERMIT FIGURES
(Thousands of Dollars)

	Actual 50 Cities	Estimated Total for U. S.
April, 1931	$48,654	$178,000
April, 1932	15,336	56,400
Per cent loss	69	69
Four months, 1931	162,617	596,000
Four months, 1932	57,015	208,900
Per cent loss	65	65

Unemployment Loan Fund for Seattle City Engineers

To aid members of the engineering department of Seattle who have been laid off, those remaining in the department are contributing one day's pay each month for six months. From the fund thus created loans are made without interest, to be repaid when the borrowers are able. The average amount contributed monthly since the first of the year is $1,488, and 25 former employees, unable to obtain positions, were receiving loans at the end of April. The maximum monthly loan is $75.

Government Engineers Take Concrete Course

Forty-three engineers representing seven offices of the United States Army Engineers Corps attended a course in field control of concrete conducted in the Portland Cement Association Laboratory, Chicago, May 2 to 7. This is the fifth consecutive year that the course has been held for engineers in charge of flood-control and navigation construction projects on the Mississippi and its tributaries. The course consisted of lectures, round-table discussions and laboratory practice dealing with concrete mixtures designed for use in flood-control and navigation structures.

Ohio Highway Department to Drill Water Wells

Contractors engaged in building highways in Ohio will drill several hundred water wells throughout the state to provide water for their work, and safe drinking water for their employees and for Ohio motorists. The wells are expected to cost about $200 each and are to be paid for as extra work. The contractor may either include the cost of the wells in his bid or put in an extra bill.

Forum on Home Building

A forum on constructing residences with the use of modern building materials will be held in the Engineering Societies Building, New York City, on May 24 and 25. The forum is sponsored by the American Institute of Steel Construction and is open to builders, architects and all persons interested in the development of more economical methods of home building. On the evening of May 24 the delegates to the forum are invited to attend a "Stainless Steel Symposium," to be held at the same address, called by the New York Section of the American Welding Society.

Baltimore's Garbage-Disposal Problem Still Unsettled

Following the filing of protests with municipal officials in Baltimore against the establishment of a large plant for the incineration of rubbish and garbage, Mayor Jackson has appointed a committee of three engineers to make a further investigation to determine whether several smaller incinerating plants should be built in various sections. The committee is made up of Bernard L. Crozier, chief engineer of Baltimore; Joseph W. Shirley, an engineer, chairman of the City Planning Commission, and Abel Wolman, chief engineer of the Maryland state department of health. Five members of a committee of nine previously appointed by the mayor suggested that the city build four plants in various sections of the city, thereby reducing cartage costs.

In a report to the city Mr. Wolman recommended construction of a 900-ton incinerator to burn both garbage and rubbish, bids for which would include not only its construction but also its operation for ten years, the city to become the owner after that time. As an alternative he suggested that the city might continue to have its garbage disposed of separately and its rubbish burned in two city-owned incinerators. In that case the existing reduction plant and the incinerators would have to be overhauled and perhaps enlarged.

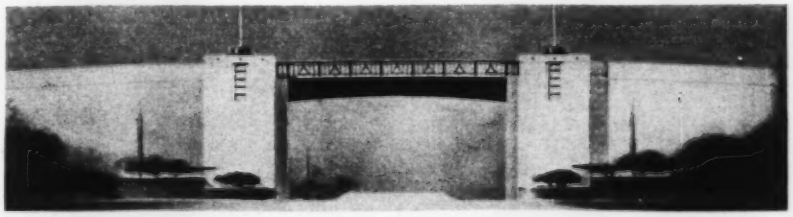
Winners Announced in Bridge Design Competition

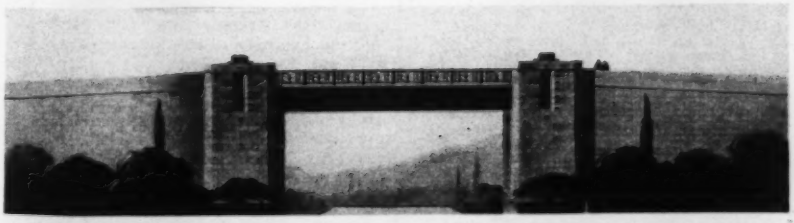
Boris R. Leven, college of architecture, University of Southern California, won first place in the annual bridge design competition held by the American Institute of Steel Construction, it is announced. The problem was to design a highway grade-separation bridge over a railroad crossing. Edward S. Okubo, from the same college, won second place in the competition, and third place went to Leslie E. McCullough, department of agriculture, Iowa State College.

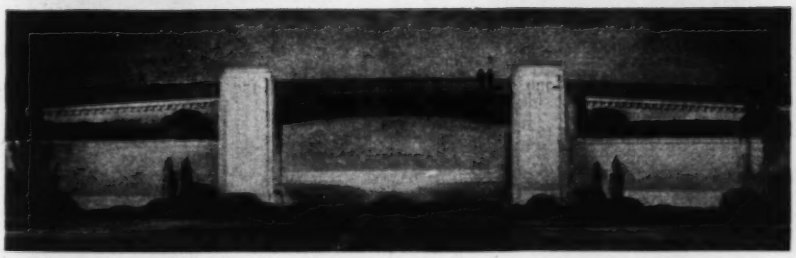
A. Lyall House, department of civil engineering, Montana State College, and Pierre A. Bezy and D. E. Campanella, both students in the school of architecture, Columbia University, received honorable mention.

These awards were made from the ten best designs selected in a preliminary competition when 111 students from 21 colleges and universities entered drawings. The jury of award consisted of Jay Downer, chief engineer, Westchester Park Commission; D. B. Steinman, consulting engineer; Harvey Wiley Corbett, architect; Ely Jacques Kahn, architect, and Russell F. Whitehead, editor of *Pencil Points*.

Top, first prize in bridge design competition, won by Boris R. Leven; center, second prize design, by Edward S. Okubo; bottom, third prize design, by Leslie E. McCullough.







Washington Notes

By Paul Wooton
Washington Correspondent

CIVILIAN engineers in the government's employ have come to the support of the amendments proposed to the economy bill creating an Administration of Public Works that would leave the employment of army and navy engineers to the discretion of the administrator. Beyond this, the civilian engineers advocate an amendment under which the administrator could utilize the services of military and naval officers only on field duty outside of the District of Columbia. Engineers in the Geological Survey and other bureaus had drafted a series of amendments to the economy bill but dropped their proposals, with the exception noted, in favor of those discussed by R. C. Marshall, Jr., vice-president, B-W Construction Co., in the May 12 issue of *Engineering News-Record*. Sentiment against including, in the centralization of the government's public-works activities, the bureaus in which construction is an incident to technical research has practically disappeared.

Federal-Aid Highway Bill

The regular federal-aid highway bill has been reported unanimously to the Senate by the committee on post offices and post roads and the steering committee has been asked to provide for its early consideration. Senator Oddie, chairman of the committee, points out that no one appeared against the bill at the hearings. The bill authorizes appropriations of $125,000,000 for federal aid for each of the fiscal years to end June 30, 1934, and June 30, 1935. In addition, the measure carries $12,500,000 for forest roads and trails and $3,000,000 for roads on the public domain. It is planned to deduct $16,000,000 annually, beginning with the 1934 fiscal year, until the $80,000,000 of emergency money made available to the states last year has been repaid. This means that only $109,000,000 will be appropriated during the two fiscal years covered by the bill.

Gen. Jackson's Assignment

Much interest attaches to the assignment which will be given Brig. Gen. Thomas H. Jackson, who on June 15 will turn over to Col. Harley B. Ferguson the presidency of the Mississippi River Commission, which he has held for four years. No announcement has been made as yet as to Gen. Jackson's assignment, but it was stated that it will be on an engineering project commensurate with his rank and experience. He will, however, revert to the rank of colonel.

Loan to Pennsylvania R.R.

To avoid interrupting work on electrification of its New York-Washington line, the Pennsylvania R.R. has agreed to raise $27,500,000 through the sale of securities with the understanding that the Reconstruction Finance Corp. will definitely commit itself to advancing a like amount on Oct. 1. The 50-50 arrangement was suggested by the Finance Corp. after it had held in suspense for two months the road's application for a loan of $55,000,000. It is expected that the amended applica-

tion filed with the I.C.C. May 12 will be promptly approved. The Pennsylvania informed the commission that it would furnish the additional $13,000,000 necessary to continue construction this year at a cost of $68,000,000.

The Pennsylvania case demonstrates the effectiveness of the pressure that the Reconstruction Finance Corp. and the I.C.C. have exerted on railroad bankers in recent weeks. In its original application March 11 the Pennsylvania advised the commission that all the usual channels of credit available to a big railroad had dried up. Bankers were represented as "reluctantly willing" to make 60- or 90-day loans but not for permanent improvements. In applying for a loan of only half the amount originally sought the Pennsylvania refers to "changed conditions" as well as the request of the Finance Corp. that the other half be obtained by the sale of securities through banking and investment channels.

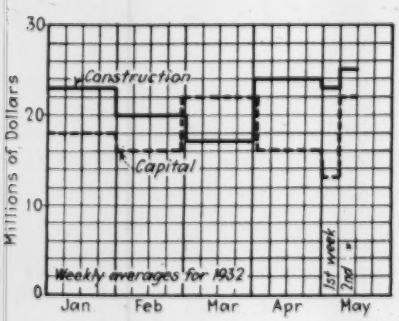
University of Texas Announces Large Building Program

The regents of the University of Texas have announced the award of contracts aggregating $3,413,737 for the erection of nine buildings on the campus in Austin. The money for the proposed improvements will come from a fund derived from royalties on oil production from land owned by the university. All the principal contracts with one exception were awarded to Texas concerns.

Capital and Contracts

Stocks and bonds issued by corporations for production purposes and bonds sold by states and municipalities for construction totaled 283 millions to May 1, compared with 1,024 millions for the first four months of 1931. Thus the volume of this year's productive capital issues is only 28 per cent of last year's volume. The 1932 figures were compiled by *Engineering News-Record* and check substantially with the 1932 figures compiled by Moody's Investor's Service. The 1931 figures are Moody's. These new capital figures include, as far as it is possible to determine, only those securities that are issued for the purchase of equipment or for construction, and exclude issues for refunding, running expenses and direct unemployment relief.

Engineering construction contracts reported during the first four months total 349 millions, compared with 980 millions in 1931. Thus this year's construction amounts to 36 per cent of last year's, and is therefore relatively heavier than the capital issues.



Total value of engineering construction contracts for the United States for the week of May 19, 1932, also new capital issues, together with year-ago comparisons, follow:

(Thousands of Dollars)

Construction:	Week of May 19, 1932	Average May, 1932	Week May, 1931
Federal government. ..	$7,128	$4,809	$2,585
State and municipal. ...	16,776	14,428	27,924
Total public.....	$23,904	$19,237	$30,509
Total private.....	7,600	7,133	23,949
Week's total	$31,504	$26,370	$54,458

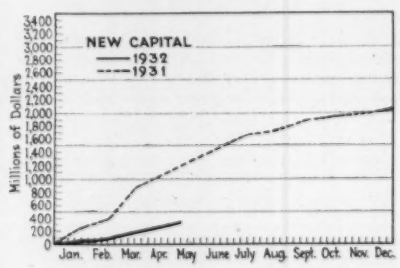
New Productive Capital:	Week of May 19 1932	Average May, 1932	Week May, 1931
Public.....	$22,000	$17,500	$28,000*
Private.....	.....	.....	26,200*
Week's total	$22,000	$17,500	$54,200*

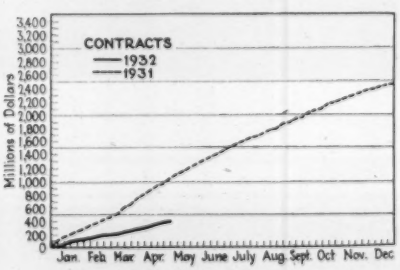
Cumulative Construction and Capital, Jan. 1 to May 19:

1932, construction $428,350
1931, construction 1,158,815
Decrease, 63 per cent

1932, capital $318,000*
1931, capital 1,160,000*
Decrease, 73 per cent

* Revised; accompanying chart also revised.





SOCIETY CALENDAR

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 20-24.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Yellowstone National Park, July 6-9.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, 40th annual meeting, Oregon State College, Corvallis, June 29-July 1.

ILLINOIS SECTION, American Water Works Association, and the division of sanitary engineering, Illinois state department of health, will hold a conference on water purification May 27 at Carbondale, Ill. Subjects under discussion will be coagulation, mixing and settling; aeration, tastes and odors; chlorination; softening and iron removal. This meeting is primarily for superintendents and operators. C. S. Gill, superintendent of waterworks, Carbondale, is making local arrangements.

MOHAWK VALLEY ENGINEERS CLUB, meeting in Utica, N. Y., May 11 re-elected the entire staff of officers as follows: president, John T. Robertson; vice-presidents, W. C. Cahill, L. A. Stewart and C. H. Briggs; secretary-treasurer, H. C. Fuller.

Personal Notes

RAY SOLADAY has been appointed combined city clerk and manager of Carlsbad, N. M., effective May 1.

MORGAN F. LARSON, former governor of New Jersey, has been appointed consulting engineer to the Port of New York Authority.

BLAKE RAGSDALE VAN LEER, who has been associated with American Engineering Council for the past four years, has accepted appointment, effective Sept. 1, as dean of engineering, University of Florida.

E. W. WILSON, who has been prominent in foreign engineering and construction undertakings for the past 25 years, sailed from New York on May 6 for Persia, where he will be assistant director general of Persian State Railways. On the eve of his departure he was tendered a farewell luncheon at the India House Club in New York City.

H. H. WATSON, for the past ten years in charge of the special construction department of the San Diego Consolidated Gas & Electric Co., has been appointed general superintendent of construction of the Northern States Power Co., a subsidiary of the Byllesby Engineering & Management Corp., and will be located in Minneapolis.

A. M. SHAW, Hangchow, China, consulting engineer for the Chinese National Construction Commission and also for the provincial government of Chekiang for the past three years, expects to return to this country in a few months and to reopen his office at New Orleans, La. He is closing up some river wall and irrigation work for the Chekiang government and will be retained to act for the national commission in an advisory capacity after his return to the United States.

Obituary

WILLIAM HOGG BAKER, president of the Merritt-Chapman & Scott Corp., of New York City, died on May 15 of heart disease at his home in Montclair, N. J. Mr. Baker was graduated in engineering from Cornell in 1901 and after some years with the Atlas Portland Cement Co. and the North American Cement Co., he joined the organization of which he later became president.

S. FRANK BENNETT, of the B. F. Bennett Building Co., Baltimore, Md., died on May 10 of heart disease. Mr. Bennett was 78 years of age and was treasurer of the Builders Exchange.

GILBERT H. LEE, of Pittsburgh, who had been working for the Soviet government for seven months as consulting specialist in the construction of a steel mill, died in Moscow on May 11 of double pneumonia.

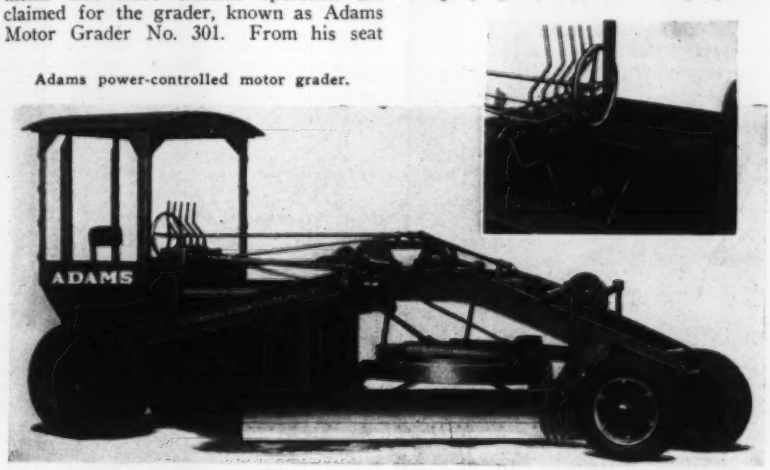
JAMES P. ANGLIN, president of Anglin-Norcross, Ltd., contracting engineers of Montreal, Canada, died on May 15. Mr. Anglin was graduated from McGill University in 1906 and organized his contracting firm in 1913. He supervised the construction of many buildings in Montreal and vicinity.

Construction Equipment and Materials

Power-Controlled Motor Grader

A new motor grader with power-operated control is announced by J. D. Adams Co., Indianapolis, Ind. This machine is powered by a McCormick-Deering I-30 tractor. Instant control, quicker adjustments and more efficient operation are claimed for the grader, known as Adams Motor Grader No. 301. From his seat the operator, with a clear view of both ends of the blade, makes all adjustments through convenient control levers. Power for operating the controls is taken from the tractor. The machine is available with blades 10, 12, 14 or 16 ft. long, with or without scarifier, and with dual pneumatic tires on the rear or equipped with the Adams tandem four-wheel drive.

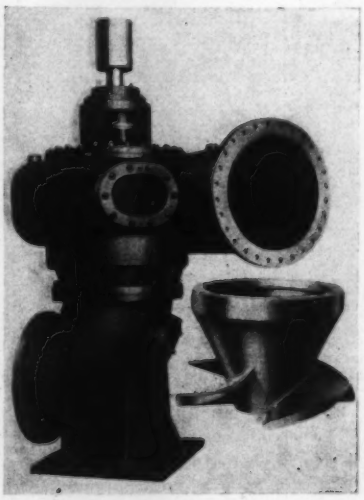
Adams power-controlled motor grader.



New Type Propeller in Heavy-Duty Centrifugal Pump

A new type of heavy-duty centrifugal pump for handling sewage and storm water or for general drainage or condenser circulation service is announced by Morris Machine Works, Baldwinville, N. Y. A special feature of this new pump is the propeller, which is of the screw type with vanes somewhat similar to those of a ship's propeller, as shown in the inset of the accompanying illustration. The propeller is fitted with widely spaced open vanes permitting passage of solids of large size without danger of clogging. Its design also permits delivering large quantities of water at low heads when operating at comparatively high rotative speeds, a feature that the manufacturer claims makes the pump better suited for direct motor drive on low head services than the standard centrifugal pump. A 42-in. pump of this design showed an efficiency of more than 85 per cent on a plant test when delivering 45,000 gal. per minute against a total head of 22½ ft. operating at 600 r.p.m. These pumps are built in sizes 16 in. and larger and for either horizontal or vertical drive.

Morris heavy-duty centrifugal pump, with screw-type propeller shown in inset.



New Equipment in Brief

Preformed Wire Rope—Broderick & Bascom Rope Co., 4203 North Union Blvd., St. Louis, Mo., has added a preformed feature of construction to its standard Yellow Strand and other grades of wire rope. The new type of construction, known as Flex-Set, is claimed to eliminate much wear on the rope, both internal and external, and also to reduce wear on sheaves, since the strands do not twist in passing over the sheave. Life of the rope is claimed to be extended from 30 to 100 per cent, according to operating conditions.

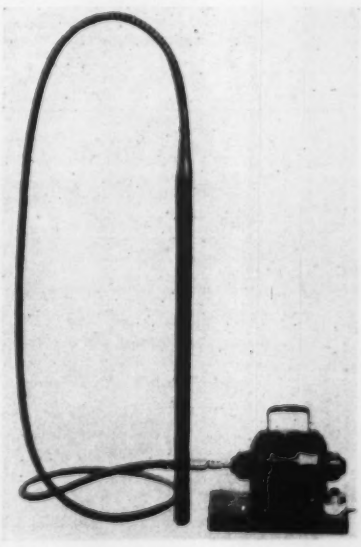
Bituminous Road Material—Lincoln-ite is the name of a new road-surfacing material developed by the Lincoln Oil Refining Co., Robinson, Ill. It is an extra-dry concentrated product from which oils and moisture, have been extracted, pulverized to pass a 100-mesh screen. The powder is used to produce a tough waterproof surface for gravel and stone roads. It is applied by means of a lime spreader to surfaces treated with road oil. The powder combines with the oil primer to form the wearing mat. A booklet describing the product and its application is available from the manufacturer.

New Protected Metal—According to a recent research report by Dr. A. W. Coffman, a new protected metal called Robertson-Bonded Metal (R-B-M) has been carried through the laboratory stages of development at Mellon Institute of Industrial Research, Pittsburgh, Pa. R-B-M is a laminated metal-felt material in which felted materials are cemented to steel with heat and pressure, utilizing metals as adhesives. The composite laminated material, the outer surfaces of which are suitable felts, is then saturated with any desired saturant chosen with reference to the corrosive condition to which the metal is to be exposed in service. The material may be sheared, bent, corrugated, rolled or mild drawn without destroying the bond between felt and metal.

New Type Vibrator Works Within Concrete Mass

A new type of vibrator known as the Viber electric tamper, for internal compaction of concrete, is announced by the Viber Co., 1919 South Hoover St., Los Angeles. The standard size Viber compactor consists of a 1¼-in. tube, 36 in. long, in which a shaft carrying an eccentric weight is caused to rotate by a ½-hp. electric motor. The tube vibrates at a rate of 5,000 vibrations per minute. In operation, the tube is inserted into the concrete, compaction being obtained in from 30 to 45 seconds. For placing concrete in deep walls, the tamper is supplied with a flexible shaft which permits proper placing at any desired depth up to 20 ft. The machine operates on 110-volt current. Complete power units, including a self-contained generator, are supplied for use where electric current is not available.

Viber concrete vibrator consists of oscillating tube.



Current Construction Unit Prices

Subway Trackwork in New York

BIDS were received April 12, 1932, by the board of transportation for track extension in the 207th St. yards of the Rapid Transit R.R., New York. The ten bids ranged from $36,897 to $48,336. The track is known as Type VII, for laying up cars, and consists of 13,800 ft. 80-lb. relayer rail on 6x8-in. ties in cinder ballast. City furnishes contact rail and protection boards. Unit prices are given of the lowest two bidders: (A) Faircraft Engineering Corp., Brooklyn; (B) Arthur A. Johnson Corp., Long Island City.

Materials:		
11,000 cu.yd. cinder ballast	$0.80	$0.85
27,500 ft. relayer rail	.27	.36
420 contact rail joints	1.35	1.40
152 special steel stops	1.80	2.15
Installing:		
13,800 ft. track	.90	.70
13,800 ft. 60-lb. contact rail	.13	.13
13,800 ft. protection board	.13	.13
29 bumping posts relocated	22.00	20.00
Metal and fiber conduit construction	1,675.00	1,750.00
Relocation signal lights	1,500.00	1,550.00
	$36,897.00	$37,293.00

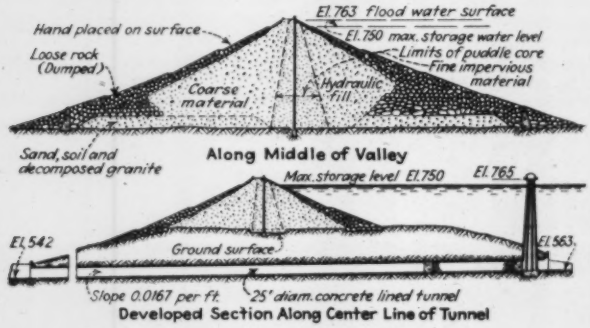
El Capitan Dam Near San Diego

EL CAPITAN dam on the San Diego River, Calif., is an earth-and-rock fill structure with maximum height of 240 ft. It is 1,150 ft. long, 2,100 ft. between upstream and downstream toes, and 20 ft. wide on top. It will add 10 m.g.d. to San Diego's water supply. Contract was let in April, 1932, by the bureau of water development for the dam, spillway and outlet works for $2,332,860.

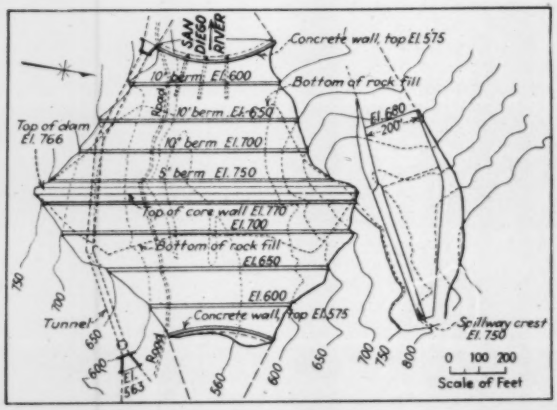
Excavation and placing the material in fill and embankment totals $1,653,000, or 71 per cent of cost of the job. The largest two items are 800,000 cu.yd. class 1 rock embankment at $1, and 1,000,000 cu.yd. class 2 earth embankment at $0.40. Classes of excavation are: (1) solid rock; (3) excavation in main cutoff trench under dam; (4) in cutoff trenches under spillway; (5) in outlet tunnel; (2) all earth, overburden, sand and gravel.

Concrete totals 64,925 cu.yd. at a contract price of $387,680, exclusive of the cement and reinforcing. The cement price is $1.90 for 67,000 bbl. in place. The 2,400,000 lb. reinforcing costs $0.03 in place. Thus the prices are $6 without cement and reinforcing, and $9.05 with. There are fifteen classes of cement used as follows:

Class	Cu.Yd.	
1	18,000 mass.	overflow spillway, outlet tower base
2	3,000	spillway, side lining, retaining walls
3	6,000	floor lining of spillway
4	3,000	unformed portion main core wall
5	7,300	formed portion main core wall
6	1,200	cutoff walls under spillway
7	2,000	outlet tower
8	10,500	retaining walls at upstream and downstream toes of dam
9	400	drains at toe
10	3,300	tunnel lining
11	1,500	tunnel floor
12	1,000	floor of tunnel approach and outlet
13	2,000	retaining and guide and cutoff walls of tunnel approach and outlet
14	600	tunnel plugs
15	125	pipe embedment in tunnel



Cross-sections El Capitan dam.



Plan of El Capitan dam.

The tunnel is for the diversion and control of the river during construction. It has a diameter of 25 ft., is 2,000 ft. long, and is lined throughout.

Five bids were received averaging $2,882,000. Unit prices are given of the lowest two: (A) H. W. Rohl, 4351 Alhambra Ave., Los Angeles, and T. E. Connolly, 461 Market St., San Francisco (contract); (B) Utah Construction Co., Salt Lake City.

	A	B
Structure excav. class 1 placed in dam, 40,000 cu.yd.	$1.00	$1.25
Embankment class 1 originating in borrowpit placed in dam, 800,000 cu yd.	1.00	.94
Structure excav. class 2 placed in hydraulic fill, 350,000 cu.yd.	.40	.56
Structure excav. class 2 placed in rolled embankment, 50,000 cu.yd.	.35	.56
Embankment class 2 originating in borrowpit, placed in hydraulic fill, 1,000,000 cu.yd.	.40	.47
Embankment class 2 originating in borrowpit, placed in rolled embankment, 70,000 cu.yd.	.35	.48
Excav. class 3 from cutoff trench placed in dam, 12,000 cu.yd.	3.00	5.00
Excav. class 4 from cutoff trench under spillway placed in dam, 5,000 cu.yd.	2.00	2.65
Excavation class 5 from tunnel placed in dam, 30,000 cu.yd.	5.00	7.00
Structure excav. class 1, wasted, 20,000 cu.yd.	1.00	1.25
Structure excav. class 2, wasted, 34,000 cu.yd.	.25	.48
Excav. class 3 cutoff trench, wasted, 1,000 cu.yd.	3.00	5.00
Excav. class 4 cutoff trench under spillway, wasted, 500 cu.yd.	1.50	2.60
Excav. class 5 outlet tunnel, wasted, 300 cu.yd.	5.00	6.50
Rock masonry in place between tunnel plugs, 4,000 cu.yd.	6.00	3.50
Backfill, 1,000 cu.yd.	.50	.70
Mass conc. class 1, 18,000 cu.yd.	4.80	5.50
Concrete class 2, 3,000 cu.yd.	9.00	9.00
Concrete class 3, 6,000 cu.yd.	4.80	6.00
Concrete class 4, 3,000 cu.yd.	4.80	5.50
Concrete class 5, 7,300 cu.yd.	4.80	5.50
Concrete class 6, 1,200 cu.yd.	4.80	6.50
Concrete class 7, 2,000 cu.yd.	15.00	14.00
Concrete class 8, 10,500 cu.yd.	4.80	7.00
Class 9 conc., 400 cu.yd.	12.00	9.75
Class 10 conc., 3,300 cu.yd.	12.00	12.50
Class 11 conc., 1,500 cu.yd.	4.80	6.75
Class 12 conc., 1,000 cu.yd.	4.80	6.00
Class 13 conc., 2,000 cu.yd.	12.00	9.50
Class 14 conc., 600 cu.yd.	4.80	7.00
Class 15 conc., 125 cu.yd.	4.80	7.00
Cement mortar, 100 cu.yd.	20.00	7.00
Cement in place, 67,000 bbl.	1.90	2.10
Reinforcing steel in place, 2,400,000 lb.	.03	.033
Structural steel in place, 496,000 lb.	.04	.055
4 in. drain tile in place, 6,000 lin.ft.	.40	.40
6 in. drain tile in place, 2,000 lin.ft.	.50	.50
8 in. drain tile in place, 1,000 lin.ft.	.60	.70
12 in. drain tile in place, 1,000 lin.ft.	.75	1.00
2 in. steel grout and drain pipe in place, 3,000 lin.ft.	.25	.40
4 in. steel grout and drain pipe in place, 1,000 lin.ft.	1.00	.90
Pressure grouting in tunnel plugs, 20,000 cu.ft.	1.00	.40
Holes drilled with concussion drills, 1,000 lin.ft.	1.00	.70
Holes drilled with core recovery drill, 1,000 lin.ft.	5.00	3.20
Grouting, 5,000 cu.ft.	1.00	.80
Copper water stop in place, 9,000 lb.	.30	.40
2-in. pipe railing in place, 300 lin.ft.	.30	1.00
Cast-iron pipe and special castings in place, 800,000 lb.	.04	.035
Placing metal work furnished by the city, 30,000 lb.	.05	.025
Totals	$2,594,050	$2,853,066